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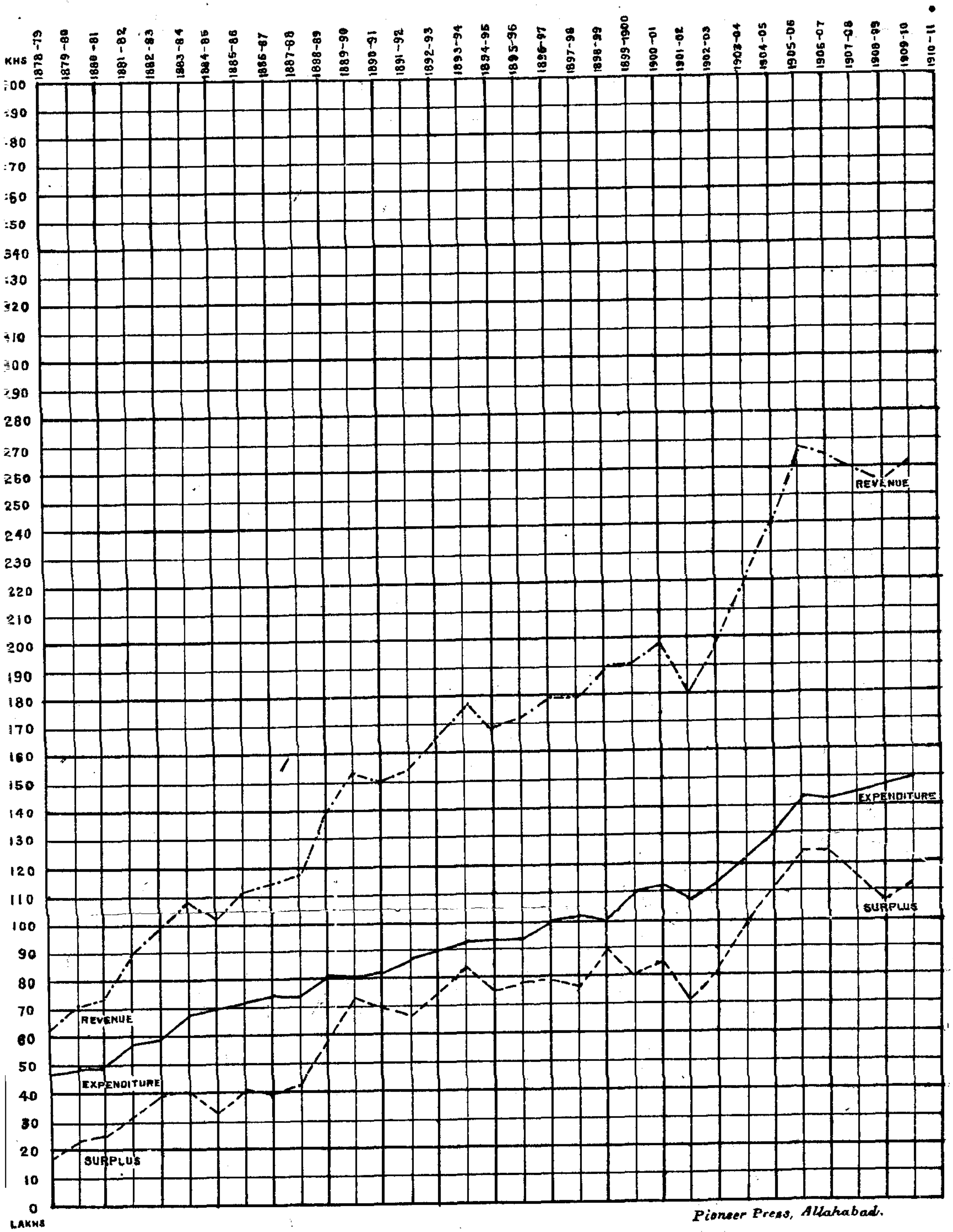
THE EXPENDITURE ON FORESTS IN INDIA AND ITS RELATION TO THE REVENUE REALISED.

[*Contributed.*]

The relation between the expenditure involved and revenue realised in all business enterprises is always a most important problem, and on its proper solution must to a great extent depend the return realised for capital invested. It is certain that no business which is not supported by sufficient funds can ever pay a proper interest on its capital, whilst on the other hand the over-capitalised concern must always pay a low rate of interest or even fail to pay any at all. The same principles hold in the management of what are known as semi-commercial departments of the Indian Empire, of which the Forest Department is one of the most important. There has been of late a spirit of what we hold to be unwise economy in the management of forest matters for, looking at conservative forest management* from a purely commercial point

* By 'conservative' is meant that the forest stock on the ground, *i. e.*, the capital, is to be kept intact and brought to its highest possible point—the annual yield, *i.e.*, the interest earned by the capital, being alone utilised.



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of view, it can be shown, we think, that up to a certain point the more money spent on forest establishment and on means of communication and transport, the greater will be the net revenue per unit of forest worked. What this point may be is as yet uncertain, but it is quite certain that in no province which possesses valuable forest has it yet been reached. Nor can it be reached until every acre of forest is being intensely worked and yielding its highest possible quota to the general revenue. At the present time this is far from being the case; there are enormous areas which are not yet under systematic management, and yielding little or nothing to the revenues of the State. There are also very large areas which are as yet not as intensely worked as they might be, either from insufficient establishment or from lack of communications. In Burma, for instance, over much of the Government forests teak is practically the only forest produce exploited, yet the country is rich in many other valuable woods needing only capital and enterprise to form the source of large and increasing profits. Again in Assam there are also enormous areas which cannot be worked until they are rendered accessible by the construction of roads or tramways. In a word, without further and considerable expenditure the forest revenues of India do not seem likely to expand to any great extent.

As showing the manner in which increased expenditure in the past has been followed by increased revenue, attention may be drawn to Appendix XXII of the Inspector-General of Forests' Review of Forest Administration in British India for the yea 1908-09 in which the forest revenue, expenditure and surplus has been given since the year 1884-85.

The gradual expansion of the forest revenue, expenditure and surplus is shown in the following table:—

—	Five years' period.				
	1884-85 to 1888-89.	1889-90 to 1893-94.	1894-95 to 1898-99.	1899-00 to 1903-04.	1904-05 to 1908-09.
	Rs.	Rs.	Rs.	Rs.	Rs.
Average revenue ...	1,16,68,148	1,59,49,015	1,77,15,756	1,96,58,421	2,57,03,161
,, expenditure ...	74,26,956	86,03,351	79,96,140	1,12,69,486	1,41,05,829
,, surplus ...	42,41,192	73,45,664	79,19,616	83,88,935	1,15,97,333
Proportion of expenditure to gross revenue ...	63·7	53·9	55·3	57·3	54·8
Proportion of surplus to gross revenue (per cent)...	36·3	46·0	44·7	42·6	45·1

The annexed interesting diagram traces the rise and fall of forest revenue, expenditure and surplus from 1879-80 to 1909-10, and shows that up to the year 1905-06 there has been a rapid and constant rise in expenditure accompanied by a corresponding rise in revenue and surplus. From time to time falls have taken place which can usually be traced to unfavourable seasons caused by drought, famine, or disease. Thus since 1905-06 there has been a fall in the revenue and surplus following the general depression in trade. The depression continued to the close of 1908-09, after which a considerable improvement took place.

Looking further into the details by provinces it is found that there are considerable differences in the percentage of expenditure to the gross revenue, the expenditure and net revenue realised per square mile of forest, and in the value of forest produce given away to the people free of charge in the various provinces. The following table gives some interesting details showing the connection between expenditure incurred and revenue realised :—

The figures given are the average of five years ending 1908-09.

Province.	Expenditure under all heads per square mile under control of the Forest Department.	Percentage of expenditure to gross revenue.	Net revenue realised per square mile of forests under the control of the Forest Department.	Value of forest produce supplied to right-holders and granted free per square mile under control of the Forest Department.	Total net return including value of forest produce supplied to right-holders and granted free per square mile under control of the Forest Department.	Percentage of expenditure to gross revenue including value of forest produce supplied to right-holders and granted free.
1	2	3	4	5	6	7
	Rs.		Rs.	Rs.	Rs.	
Bengal	76	56.2	60	23	83	48.0
United Provinces ...	313	54.7	259	52	311	50.1
Punjab	119	61.8	56	88	144	45.2
Burma	28	39.0	45	2	47	37.7
Eastern Bengal and Assam ...	25	57.2	19	17	36	41.0
Central Provinces and Berar...	66	65.1	35	9	44	59.6
*Coorg	186	41.5	262	.6	262.6	41.4
†North-West Frontier Province	369	56.8	398	82	480	50.4
Ajmer	118	81.0	28	129	157	43.0
Baluchistan	79	127.5	...	44	44	74.3
Andamans	142	60.1	94	8	102	58.0
Madras	127	73.7	45	5	50	71.4
Bombay	142	58.4	101	113	214	39.9

* The high return given by Coorg is due to the great value of its principal timber, sandalwood.
† The area is small, 236 square miles only, the principal timber, deodar, is valuable.

Certain facts appear clear from the above. First it is evident that the financial position in any province cannot be judged by the percentage of expenditure to gross revenue. At the present time our Indian forests are very far from being in full bearing. The more accessible areas have been overworked and have to be nursed for a while. In such cases money put into them will not bear immediate return but will pay a hundred-fold in the future. In a great many other cases the forests are not being worked at all or are being worked only for the most valuable species. As the forests are opened out and come into full bearing, the percentage of the total expenditure to gross revenue may be expected eventually to decrease, but it must always be larger in provinces where the yield of the forests is least valuable, the means of extraction costly, or the demands of the people excessive. The percentage of expenditure to revenue must always vary considerably following these factors; thus in Burma the percentage of charges to revenue is very low. Here we have the most valuable timber of the Indian Empire, *viz.*, teak, brought out very cheaply by water transport with a demand by the people from the Government forests which is insignificant compared with the total outturn. Yet this low percentage of expenditure to revenue is not a sign of really satisfactory forest management. In the case of Burma it means that the forests are in the main worked only for the most valuable product—teak. There are enormous stores of other valuable timbers and other forest produce that cannot be brought to market until very considerable sums are expended in the opening out of communications and in strengthening the staff. The percentage of expenditure to revenue will then rise considerably for a time at any rate, but so will the net revenue and the return per square mile of forests will also rise. At present this is Rs. 45* only in Burma as compared with Rs. 259 in the United Provinces. In these provinces the percentage of expenditure to the revenue is 54 per cent as against 39 per cent in Burma, so it is evident that the best results for a given area of forest cannot be obtained by striving to show the lowest possible percentage of expenditure to revenue.

* These figures are averages for the five years ending 1908-09.

Next, it is apparent that the financial position in any province can only be judged by the net revenue realised per unit of forests. Taking this per square mile under control of the Forest Department, we find that the North-West Frontier Province has a net revenue per square mile of Rs. 398, this province also shows the highest expenditure per square mile, *viz.*, Rs. 369. Omitting Coorg which shows a high net return per square mile owing to the great value of its principal produce sandalwood, we find that the second best position is held by the United Provinces with a net annual return per square mile of Rs. 259; at the same time these provinces show the second highest expenditure per square mile, *i.e.*, Rs. 313. The same relation between the expenditure and the *net* revenue realised per unit of forest managed may be traced in the other provinces in varying degrees according to circumstances. In some provinces high net returns cannot be expected owing either to the small value of the forest produce available or the quantity of produce which is given away to the people, *e.g.*, the Central Provinces and Ajmer. But it may be safely asserted that in provinces, where the forest produce is valuable and not yet fully worked, increased expenditure is necessary in order to earn increased revenue.

It may no doubt be held that the steady rise in the forest revenue which is shown to have occurred during the past 20 years has been caused by the general development of the country, the spread of railways and roads and consequent improved markets, and increased prices for forest produce,* and that the increased expenditure has grown with the revenue and has had little to do with the earning of it—no doubt these factors have all influenced the forest revenues and there is no doubt that the royalty payable on some of the more valuable forest products has increased considerably, but on the other hand vast quantities of forest produce are brought out from areas which formerly were not worked at all, and many timbers of inferior species and much minor forest produce is brought out and sold which of old was left to be wasted in the

* We have endeavoured to trace how far increased prices have caused increased revenue, but so far we cannot form any definite conclusions. The matter is very obscure owing to changes in methods of collecting royalty.

forests. This has been rendered possible only by the construction of forest roads, tramways and the like, by which alone the bulk of our forest produce can be brought to market. It is in the construction of roads and other means of communication that increased expenditure will show the quickest return in increased revenue.

In the foregoing tables and observations the total expenditure under all heads has been included and considered, and we have seen that in the five years ending 1908-09 amongst the major provinces, the province which spent the most money per square mile was able to show the largest net revenue per square mile of forest managed. *In these figures, however, are included many* items of extraordinary expenditure, such as those incurred on forest settlement, forest surveys and demarcation, which, however necessary, do not tend directly to increase the forest revenue. Let us endeavour to trace how expenditure on establishment alone has influenced the forest revenue. The following gives the amount spent on permanent and temporary establishments combined with revenue realised during the past 20 years :—

Year.	Amount spent on permanent and temporary establishments combined.	Average annual increase of column (2) as compared with the previous five years.	Net revenue realised.	Average annual increase of column (4) as compared with the previous five years.
1	2	3	4	5
	Rs.	Rs.	Rs.	Rs.
1890-91	29,95,824		69,04,010	
1891-92	30,82,159		67,22,828	
1892-93	33,62,710	6,92,691	74,38,110	23,03,901
1893-94	35,24,310		83,72,320	
1894-95	37,50,070		74,15,590	
1895-96	38,36,330		77,66,770	
1896-97	38,53,440		78,11,360	
1897-98	39,98,030	6,39,323	75,99,760	6,62,912
1898-99	40,76,260		90,04,600	
1899-00	41,47,630		79,84,930	
1900-01	42,11,228		86,10,453	
1901-02	42,58,133		70,77,327	
1902-03	43,42,417	3,54,593	82,22,209	9,70,883
1903-04	44,16,622		1,00,49,754	
1904-05	44,56,256		1,10,62,094	
1905-06	45,87,751		1,24,16,072	
1906-07	48,18,787		1,24,27,686	
1907-08	52,55,075	8,79,725	1,13,50,046	26,01,575
1908-09	55,51,589		1,07,30,765	
1909-10	58,70,080		1,11,05,140	

From this it is apparent that following an increase on establishment charges of Rs. 28,74,256 or nearly 50 per cent during the past 20 years, there has been a corresponding increase of Rs. 42,01,130 or 38 per cent on the net annual revenue realised.

As fresh forest tracts are opened out by the construction of forest roads and it is desired to work them systematically, increased establishment becomes necessary. Working-plans have to be prepared so that the forest capital may be kept intact and not wasted by over-cutting. The trees have to be marked, timber operations supervised, theft and illicit working guarded against, depôts have to be established and arrangements made to realise the revenue due. As larger areas come under control and working, fresh divisions have to be formed and new Conservators have to be appointed. This increased establishment is absolutely necessary if conservative forest management is to accompany increased revenue. Again, numerous steps are necessary if our forests are to be kept intact and brought to, and maintained in, such a condition that they will permanently yield the highest net return. The young crops must be tended and the reproduction of the forests, particularly as regards the most valuable species, must be insured, whether by cultural operations, plantations or improvement fellings. As a rule all valuable forest-bearing tracts must be protected from fire, and the estate as a whole has to be protected from theft and injury. Measures must also be taken to ensure that a proper education is given to the staff that has to manage these estates, and to carry out scientific research by which new sources of forest revenue may be opened out.

The averages of the five years ending 1899-1900* compared with the averages of five years ending 1908-09 are shown in the following statement:—

Details of expenditure.	Five years ending 1899-1900.	Five years ending 1908-09.
	Rs.	Rs.
1. Total forest expenditure	1,12,69,486	1,41,05,829
2. Forest settlements, surveys and demarcation ...	5,96,814	4,76,133
3. Extraction, and construction of roads and buildings.	5,03,401	10,54,645
4. Fire-protection	4,09,837	5,81,056
5. Cultural operations	3,53,845	5,65,914
6. Forest science and education	73,088	1,24,162

* F res for earlier periods are not available under all heads.

Money spent on matters such as these does not directly produce revenue. The expenditure is capital and not ordinary, but if any of these matters receive insufficient attention the forest estate will decline in value and will not bring in to its owner, Government, the full revenue, or to the people the full advantages which may legitimately be expected from it. This capital expenditure will become less and less as time goes on, but will not cease in India for a long period of years yet.

In Europe all expenses of constitution, such as settlement, survey and demarcation, have been met long ago. Expenditure on fire conservancy is not generally necessary, and rates of pay for establishment are lower than in India. Roads have for the most part been constructed and only repairs have to be paid for. The forests are fully worked and every stick of material can be sold at prices which are very high compared with present prices in India. It is therefore not surprising to find that the percentage of expenditure to gross revenue is not usually so high as obtains in India and that the net revenue per unit is very much greater. The following table, which was placed before the Royal Commission on Coast Erosion, may be studied with advantage:—

Country.	Area of Forests. Acres.	Revenue per acre of total area. Shillings.	Net return per acre. Shillings.	Percentage of expenditure to gross revenue.	REMARKS.
1. Prussia	7,130,912	17·3	10·0	42·2	A net return per acre of 10 shillings is equal to Rs. 4,800 per square mile. Compare this with the net return per square mile from the Indian forests which nowhere exceeds Rs. 259 in the major provinces.
2. Bavaria	2,315,252	17·8	10·4	41·6	
3. Wurtemberg	483,437	37·4	25·3	32·3	
4. Saxony	443,312	32·7	21·2	35·1	
5. Alsace-Lorraine	380,649	19·4	12·0	38·1	
6. Baden	234,455	33·4	19·9	40·4	
7. Brunswick	210,338	21·1	11·3	46·4	
8. Hesse Darmstadt—					
(a) State Forests...	8,114	18·1	9·4	48·0	
(b) Domain Forests	170,687	23·7	11·3	52·3	
9. Saxe-Weimar	114,349	26·7	17·7	33·7	
10. Saxe-Meiningen	109,878	29·8	21·3	28·5	
11. Anhalt	71,563	21·1	16·6	21·3	
12. Waldeck-Pyrmont	67,330	10·4	6·2	40·3	
13. Oldenburg—					
(a) Duchy of Oldenburg	38,505	8·7	4·9	43·6	
(b) Principality of Birkenfeld... ...	16,015	13·0	6·5	50·0	
(c) Principality of Lubeck	9,954	20·8	12·2	41·3	
14. Schwarzburg-Rudolstadt	51,979	24·7	18·1	26·7	
15. Schwarzburg-Sondershausen	42,620	26·3	18·1	31·1	

Whilst admitting that improved prices may have had some effect on the increased revenue of the past 20 years, I have above attempted to show that it is mainly by increased expenditure on roads, tramways and other mechanical means of transport, accompanied by an increased establishment, that increased revenue has been earned in the past and must be earned in the future. Let us now examine the figures of outturn of timber and fuel and see how far they justify this view. The following table is of great interest in this connection:—

Province.	Timber removed by Government Agency.		Timber removed by purchasers.		Average total outturn, Timber.		Fuel removed by Government Agency.	
	Average of 5 years ending 1908-09 (c.ft.)	Average of 5 years ending 1896-97 (c. ft.)	Average of 5 years ending 1908-09 (c. ft.)	Average of 5 years ending 1896-97 (c. ft.)	Five years ending 1908-09 (c. ft.)	Five years ending 1896-97 (c. ft.)	Average of 5 years ending 1908-09 (c. ft.)	Average of 5 years ending 1896-97 (c. ft.)
Bengal	89,497	182,306	5,152,139	5,398,178			152,794	127,434
United Provinces	152,832	532,806	4,186,339	277,686			609,968	2,531,337
Punjab and North-West Frontier Province.	815,074	756,030	3,994,386	489,786			2,153,564	2,528,427
Burma	3,939,957	2,814,544	23,623,754	19,720,608			215,680	2,236
Eastern Bengal and Assam ...	434,693	83,391	4,585,330	2,857,410			27,283	10,398
Central Provinces and Berar ...	887,517	281,372	3,333,191	1,646,117	59,459,969	45,491,226	1,121,739	1,781,162
Coorg	105,119	78,380	149,407	311,625			16,004	...
Ajmer	478	167	3,922	11,385			23,662	221
Baluchistan	745	544	6,863	2,911			47,486	10,430
Andamans	534,627	300,132	35,699	47,898			678,497	17,254
Madras	652,329	366,496	2,190,116	2,450,160			11,659,673	2,538,820
Bombay	1,106,151	1,404,464	3,479,804	5,476,800			4,371,790	14,850,110
Total ...	8,719,019	6,800,632	50,740,950	38,690,594	...	...	21,078,140	24,397,829

Province.	Fuel removed by purchasers.		Average total outturn fuel.		Average total outturn of timber and fuel for five years ending.		Average total outturn of timber and fuel per square mile of reserved and protected forest.	
	Average of 5 years ending 1908-09 (c. ft.)	Average of 5 years ending 1896-97 (c. ft.)	Five years ending 1908-09 (c. ft.)	Five years ending 1896-97 (c. ft.)	1908-09 (c. ft.)	1896-97 (c. ft.)	Five years ending 1908-09 (c. ft.)	Five years ending 1896-97 (c. ft.)
Bengal	16,936,823	19,547,999					4,709	3,892
United Provinces	6,944,772	2,880,525					3,872	3,452
Punjab and North-West Frontier Province	2,168,126	1,580,380					3,948	4,338
Burma	14,871,044	10,357,213					454	1,872
Eastern Bengal and Assam ...	4,934,462	1,685,136					825	353
entral Provinces and Berar ...	14,399,669	11,968,927					1,048	702
			116,574,182	104,337,489	176,034,151	149,828,715		
Coorg	68,050	218,240					449	645
Ajmer	548,743	252,688					4,124	1,979
Baluchistan	346,407	441,681					229	768
Andamans	8,791	526,975					3,630	3,148
Madras	9,292,784	9,859,360					*1,236	*833
Bombay	24,976,371	20,620,536					*2,938	*3,205
Total ...	95,496,042	79,939,660	...	...	...	...	27,462	25,187

* Includes all forest areas. Separate figures are not given for reserved and protected forests in Madras and Bombay.

Average surplus for the 5 years ending 1908-09 was Rs. 1,15,97333—average surplus for the 5 years ending 1898-99 was Rs. 79,19,616.

We see therefore that with some few exceptions there has been a general and very considerable increase in outturn of both timber and fuel, not only in the total amount exported but in the outturn per square mile of reserved and protected forests under the control of the Forest Department. This increased outturn is the main cause of the increased net revenue, and this has been rendered possible only by increased expenditure.

Again let us consider the returns from minor forest produce. The following shows the revenue realised for the five years ending 1908-09 as compared with the five previous years :—

Minor Forest Produce.

Year.	Annual revenue.	Average annual revenue for quinquennium.	Year.	Annual revenue.	Average annual revenue for quinquennium.	Remarks.
	Rs.	Rs.		Rs.	Rs.	
1899-1900	38,44,750		1904-1905	41,46,781		
1900-1901	39,28,866		1905-1906	48,81.696		
1901-1902	32,01,402	34,60,464	1906-1907	49,38,061	48,29,631	
1902-1903	33,61,047		1907-1908	51,84,210		
1903-1904	34,66,257		1908-1909	49,97.407		
Tota ...	1,73,02,322		Total ...	2,41,48,155		

There has thus been an average annual increase of nearly 14 lakhs of rupees. Apart from grazing, from which some 22 lakhs are annually realised, the revenue is realised from a variety of articles such as fodder and thatching grass, resin and turpentine, gums and barks, rubber, horns and hides, etc. The increase in revenue is directly due to the opening out of forests by roads, without which the bulk of such produce would not reach the markets at all; in some measure it may also be ascribed to increased establishment without which neither could extraction be controlled nor the revenue due be realised.

A few remarks are necessary regarding expenditure on Forest scientific research and education. These charges have risen considerably of late years, and in 1908-09 stood at Rs. 1,83,191 as against Rs. 73,550 ten years ago. This is chiefly due to the creation of the Forest Research Institute at Dehra Dun and to the endeavours that have been made of late years to improve the education given to Rangers and to candidates for the provincial service. It cannot, we think, be gainsaid that on the proper education of these officers the proper management of the Government forest estates, and the amount of net revenue they can be made to yield, in great measure depends. This will be more than ever so in the future, the accepted policy being to employ natives of India more and more in charge of forest divisions. A practically new *provincial service, with very favourable rates of pay, has lately been* sanctioned, and it is the duty of Government to see that candidates for this service should receive a first class education such as will fit them for the responsible positions which they will hold. Any undue economy in this direction must have the most injurious effect on the country as well as on the forest revenues.

Again to Forest research we must chiefly look for the discovery of fresh sources of revenue. Already numerous investigations are in progress, such as the possibility of manufacturing tannin extracts from Indian forest products, on the suitability of various fibres, grasses, bamboos and timbers for the manufacture of paper, on the possibility of opening out a trade in timbers not yet utilised, and the fostering of the match-making industry in

India. These researches deserve the fullest support from the Government of India leading, as they surely will, to large increases of trade and Government revenue.

From the statistics of past years, and the considerations which we have endeavoured to bring forward above, it may, we think, be concluded—

(*i*) That a low percentage of forest expenditure to gross revenue realised cannot in India be considered as proving the most satisfactory management from a commercial point of view.

(*ii*) That this must be judged by the net revenue realised per unit of forest concerned, and that the best results in the present condition of Indian forestry cannot be realised without a high percentage of expenditure to revenue, and a high expenditure per square mile.

(*iii*) That if it is desired to increase the net forest revenue it *will* be necessary to increase and not decrease the expenditure, especially on establishments and means of communications in provinces where there is valuable produce, and which are not yet worked to their full capacity, and that such increase of expenditure will lead to an increased net revenue per square mile and eventual decrease in the percentage of revenue to expenditure.

(*iv*) That undue economy in expenditure on education and research must result in injury to the forests and the country and in the failure to open out new sources of revenue.

(*v*) Finally, that large areas of forests in India are managed almost entirely for the benefit of the people, and not as revenue-paying estates. For the protection and management of these forests considerable expenditure is necessary, a return being received not in the shape of revenue, but in the fact that the people receive free of payment forest produce to the value of more than 45 lakhs of rupees per annum.

DEPARTMENTAL TEAK EXTRACTION IN THE ZIGON DIVISION, BURMA.

Most of the teak forests of Burma are worked by purchase contractors under leases from the Government. For various reasons the forests in the basin of the Hlaing river are worked by the Department direct. These forests lie on the western slopes of the Pegu Yomas in the Zigon, Tharrawaddy and Prome Divisions, but I am now only concerned with the former. The streams which drain the Zigon forests, and down which all the teak logs are floated, flow into the Myitmaka or Hlaing river, which is the river on which Rangoon stands. The timber thus floats direct to its market, and has the advantage over timber from most other divisions that it does not have to be brought through any side creeks or canals in the delta region.

The lengths of float are as follows:—

(i) From the forest to the shallows, where all the four floating streams of the division become badly silted on reaching dead water, from 20 to 30 miles.

(ii) Down the Myitmaka or Hlaing river to the Sanywe depôt where measurement is done, 94, 79, 61, and 52 miles, respectively, for the four streams.

(iii) From the Sanywe depôt to the Rangoon depôt, about 100 miles. In the floating streams the rises in two are practically always good, and in the other two usually, so that there is not much to complain of on that score. Three of the four streams, however, are badly encumbered by silting in their lower reaches and logs from the stream with the biggest outturn have two series of shallows to get over. Over these shallows in all cases the logs have to be dragged by elephants or men.

2. The kind of timber extracted, that is the length of the logs and correctness of the logging, depends largely on the kind of contract in force, and on the supervision the contractor's work gets. But most of all it depends on the way in which the outturn is paid for, as a contractor will unnaturally do those things which

it is financially most worth his while to do. There have been three kinds of contract used at various times on this work, and their chief points of difference are in the methods of paying for the timber. As regards supervision, the work of extraction has until the last two years had practically none, as no special officer could be deputed for the work and the divisional officer had his hands far too full of sylvicultural operations, and the like, to be able to find the time necessary to visit the more remote places where extraction was going on. Under such conditions the contract and the inducements it had to offer were all that could be looked to keep extraction in the state it should be in, and it would be a very comprehensive and elaborate contract that could offer inducements likely to check all the many malpractices that were current.

3. The earliest form of contract provided for the payment for the timber at fixed rates for each class. The classes were determined only by the length and girth of the logs. The biggest class was for those logs over 22 feet long and over six feet girth, and the rate paid was Rs. 22 a ton, delivered at Rangoon. The result of such payments was that logs were cut just to the required length and no more. If a tree was of a girth that would not enter class I, it would be logged of such a length as just to qualify for class II, while if over six feet girth, it would be cut just 22 or 23 feet long, as that was all that was necessary. The object of this was that the logs, while qualifying for the maximum rate to which their girth entitled them, might yet be as light as possible for the elephants to drag. I do not say this is financially sound though the contractors seem to have thought it was. I have not gone into the matter but it seems that it was merely throwing money away to butt off say six feet from the top of a log and abandon that six feet so that the log might only just qualify for its class. That six feet would have been paid for at the same rate as the rest of the log had it not been butted off. Be this as it may, that is what the contractors used to do, and I have seen these ancient butts from the top ends of logs lying in the forest. It is thus evident that in some cases logs were cut shorter than the

elephants could have dragged, so that this form of contract did not tend to produce the longest timber possible. As each successive class had a smaller and smaller rate, the smaller the log the less the contractor bothered about it, and very little insistence could be laid on the entire clearing up of the forest. The result was very few, if any, small or "refuse" logs, these all being left in the forest in the tops, and gradually getting burnt up.

As an example of my statement that the general run of the logs cut under such contracts as this was smaller than that cut under the second form of contract, to be described below, I may mention that there are two streams in this division still containing 400 logs that were originally cut under such contracts. The smaller size of the timber is at once obvious.

Other disadvantages of this form of contract were the absence of any logging rules and the many classes, involving much office work in the preparation of contractors' accounts.

4. The second type of contract was introduced about eight years ago. In this the payment was by a sliding scale. There were only two classes, one for big logs, the other for small and "refuse" logs. The rate for the first class logs depended on the average log. It was Rs. 10 plus or minus 3 annas for every cubic foot by which the average log exceeded or fell short of 50 c. ft. The second class had a fixed rate of Rs. 8 per ton.

Such rates as these put a very effectual stop to the cutting of logs shorter than the elephants' maximum capacity. It was now the object of every contractor to get his average log in the nineties, and to extract no logs much less than about 80 c. ft. unless they were sure to go into class II. Even then the contractors did not believe that class II paid them, and gave as little attention to it as they were allowed to. Owing to the lack of supervision already mentioned, they could almost do as they liked in this respect, and hardly cut any small or "refuse" logs. All their energies were turned to the remunerative big logs. The rate used to work up to Rs. 18 or so a ton, and there being no girth limits, it made for long logs. There can be no doubt that this form of contract ncreased the length of the timber extracted

Besides making contractors cut up to full elephant power, it had the obvious advantage of causing less office work.

The object of the second class was to include all the small logs from the tops, which would otherwise be wasted. It was hence not possible to have a sliding rate dependant on the average log or the smallest logs would have been left behind, as tending to lower this average, yet even the very smallest logs that are still marketable are wanted. A fixed rate was therefore necessary and, on account of the smaller value of the timber, it must be small so that no elephant-owning contractor will care to employ his elephants on such low paid logs, unless he must. Consequently only supervision and driving, with a threat of fines, can ever get all the available small logs extracted. It might really be financially worth the while of a man owning only one elephant, with buffaloes, to work only small logs, the large number he could work from places which buffaloes could not ordinarily get at would counterbalance the low rate, but no such contractors will think for a moment of such a method of work.

The disadvantages of this form of contract would seem to be the following :—

(*a*) There is no inducement to good logging. For example, if there is a bulge in a log the contractor manœuvres to get that in the middle of his log. If a tree forks he will cut one branch at the fork, the other some fifteen feet beyond it, but always so that the centre girth comes on the large sized part of the log. Again, a straight log will be disfigured by the inclusion of a crooked piece which should have been left in the crown, merely to get extra length. Then, starting from the bottom of the tree the contractor always cuts the biggest log he could drag, so that such log often contained a hollow. This would mean that a tree which could have yielded a bottom log of 15 feet length to the end of the hollow and then a second log of 30 feet, sound and free from branches, would be cut so that the 30 foot log would be at the bottom, hollow

for half its length, and the 15 foot log at the top. The contractor would stand to lose nothing by so doing but would have spoilt a very fine log.

(*b*) Some trees, for sylvicultural reasons, have to be girdled, under size. Such will, as a rule, yield logs of 60 or 70 c. ft. only. Logs from such trees were held to be likely to reduce the average of class I, so such trees were either not felled or felled and cut up into short lengths of 25 c. ft. so as to be sure to go into class II, although the whole bole might have been quite sound.

(*c*) Similarly, trees standing in difficult places which could only be extracted in 60 or 70 c. ft. lengths, but not in 80 or 90 c. ft. lengths, used to be left unfelled.

(*d*) The desire for a very big average log made it still harder to get difficult compartments taken up, compartments where such very big logs would be either a source of trouble, or beyond the capacity of the elephants.

5. The third form of contract has only been introduced this year. It is a modification of the last, retaining the sliding rate to keep up the length of the logs, but introducing logging rules, fines for bad logging, and a special class for the very best logs which are deemed capable of yielding squares fit for Admiralty use. Disadvantages *b*, *c*, and *d* still however remain, and must be fought by supervision, as must also the tendency on the part of elephant contractors not to bring out their small logs.

The classes now are therefore—

First class—logs over 75 c. ft. and over 25 feet long, straight, sound and free from branches—a sliding rate.

Second class—logs over 50 c. ft. not classed as first or as "refuse," a sliding rate less than the first class one.

Third class—logs less than 50 c. ft. and such logs over that size as may be classed as "refuse," a fixed rate.

It may be easy enough to point to disadvantages, but it is not so easy to point to remedies. In this case the disadvantages are still the objection of the contractors to 60 or 70 c. ft. logs, and their objection to extracting "refuse." The first could be overcome

by splitting up the second class into two, one for over 75 c. ft. and one for logs under that size, both with a sliding scale. It would then be of more advantage to extract a log of 65 c. ft. as such rather than to cut it into two, as it would not be reducing the average of the really big logs in that class.

As regards "refuse," contractors have such an objection to using their elephants on small logs that usually they hire buffaloes to drag them and this means that they are often cut unnecessarily small. I have already pointed out why I think a fixed rate must be given for small logs but to split class III into two, for logs over and under 30 c. ft., the one with a fixed rate of about Rs. 10 and the other with Rs. 8 seems as if it would help to prevent these logs from being cut smaller than necessary.

I myself would welcome a contract with five such classes, as being as far as it is possible to go in the multiplication of classes, but I have no doubt my clerks would not, and I regard it as an open question whether the benefit to be gained by this further subdivision of classes is sufficient to warrant the extra work in classification and preparation of accounts that it would entail. It may be said that I have still made no provision for what a contractor is likely to do with a log of 50 c. ft., but I think I have gone far enough in my subdivision of classes although the further one can subdivide the more worth the contractor's while is it to extract every log in the longest straight length available.

6. Since writing the above a conference has been held at Prome at which the contract form was modified on very much the lines I have been suggesting, both the first and second classes being split into three, but this does not seem any reason for holding this article back.

7. Besides the form of contract and the method of paying for the timber produced, the work of contractors is influenced by the way contracts are given to them, that is, by the number of trees per elephant and the kind. Formerly it used to be the practice to give extensive contracts for the extraction of dead teak timber either standing or fallen. In some reserves the whole forest would be split up into four or five big blocks, corresponding with the

drainages of the chief rivers in it, and a contract for dead and fallen teak would be given in each block to a big contractor. This was when the working-plan girdlings alone were not enough to occupy all the elephants available. The result of this was two-fold. Owing to the size of the areas the contractors were able to pick and choose and the easy parts became worked out. Owing to the absence of supervision, illicit girdling to provide the dead timber in readily accessible places was freely indulged in. It was all that could have been expected. In one reserve practically all the contractors had to be broken in the same year for this offence.

Then it became the exception, not the rule, to give contracts for dead and fallen timber, and this tends to concentrate working and make it possible to know for certain, years afterwards, which contractor has committed any faults of extraction that one may discover. Now and again contracts for dead and fallen timber may still be advisable when girdlings happen to be short, but usually there is only too big a balance of unextracted girdlings waiting, and also with the present supervision a few such contracts can safely be given.

8. In my opening paragraph I have made mention of the shallows which occur on all our floating streams, and these places have a considerable bearing on the whole question of extraction in this division. While a contractor is logging his trees he is very likely wondering how he is going to get the big logs past these shallows, and in some cases it must influence the size he cuts them into.

The shallows occur in the plains some way from the foot of the hills and are caused by the river water meeting the flood water from the Irrawaddy where there is very little fall to help the former. This part of Burma may not be commonly called so, but it undoubtedly is really the beginning of the Irrawaddy delta, as most of the country between the Myitmaka or Hlaing river and the Irrawaddy is submerged in the rains and a good number of big and little channels connect the two rivers. This flooding extends several miles east of the Myitmaka and it is where the floating stream water begins to feel these floods and be checked.

by them that silt is deposited and shallows are formed. To see any one of these shallows in the rains is an impressive sight, and makes one wonder how so much timber is ever got past. What has a few miles above been a stately stream with high banks and a large volume of water has dwindled to the veriest ditch out of which the water takes every possible opportunity of escape, both over such banks as are left and down innumerable side channels. The whole country, ordinarily supposed to be paddy fields, becomes a lake in which here and there the remains of paddy plants may be seen which have been put in early by some enthusiastic cultivator. (He has frequently to plant his paddy as much as three times, and that crop succeeds, more or less, which happens to remain still rooted when the floods subside.) The logs follow the water, that is, they go everywhere, but there is usually some kind of channel within which attempts are made to keep them. Small logs give the most trouble as it does not need much depth of water to send them far afield, so that the whole place becomes strewn with logs in all directions as far as one can see. Elephants have to be sent to these shallows every year as without their help scarcely a log would get through, and this is a job that the elephant owners particularly detest, and with reason. The elephants have to come in about five days' journey from the forests where they were following their proper vocation in following their logs down the stream after every rise, and pushing them off from the rocks and banks where they had stuck. There is no road to come by as all the tracks are across paddy fields which are planted up by that time. The elephants have to follow down the banks of the stream and go where there is least paddy and there are fewest paddy bunds to destroy, or the owner will be inundated with demands for compensation, even if his elephants are not speared in the leg at night. When they get to the shallows the elephants have to work all day in from one to five feet of water over one or two feet of mud, and to drag big logs over sand, let alone mud, is hard work when their feet sink in so much at every step. At night it is hard to find a dry spot for the elephants to graze or sleep on; all that is not planted up paddy fields is

submerged land, and the weary elephants show a great desire to wander and eat the tempting young paddy plants. Sometimes paddy has to be bought to feed the elephants on while at this work. Having had his elephants on the shallows for a month, during which time a contractor may have got about half his outturn over, they will probably have to be laid by for another month to recover. No wonder the work is not exactly popular!

9. This year the stream which is giving most trouble is the biggest one we have. It drains 167 square miles of reserved forest and has good rises. Where it passes under the Rangoon-Prome Railway it is quite an imposing stream, but it does not go much further like that. Several years ago the P. W. D. made a road across the country where this stream meets the flood waters, evidently all unware of what was going to happen. The channel the stream was then following was nearly silted up so that it did not receive much of a bridge and it being quite impossible to say where the stream would go next, no big bridge was made elsewhere. That year the stream abandoned its previous course altogether leaving the bridge high and dry, and turned to the south. For several years it wandered over the country, now going under this bridge now under that, usually finding the particular bridge it had selected much too small and washing out the approaches on one or both sides. Then in 1908 it treated the biggest bridge in this way and in 1909 abandoned it for the smallest, and to get at this small bridge it found it convenient to go along the borrow-pits and make a right-angled turn at the bridge. This sufficed for 1909 and 1910 during both of which years over 2,000 logs were got through that little bridge, and the road answered splendidly as a bund on one side. But this year the road has given up the unequal struggle and has been breached in four yawning gaps, through which the water is pouring at present like a mill-race with a mighty rushing sound. Some 500 logs have already gone through, but this way leads to nowhere but wastes of elephant grass and thickly overgrown fisheries, so that they will have to come back, somehow some time.

Logs from this particular stream, as if they had not passed through enough trials already, have a further series of shallows to

get over lower down in the Myitmaka river. This is where our second floating stream used to meet the Myitmaka exactly at right angles. This formed a fine whirlpool, held back the Myitmaka and deposited much silt where the slack water occurred. Then we had the phenomenon of the water running backwards up the Myitmaka over the shallows, instead of down, and logs had to be poled down, one by one, against a stiff current flowing the wrong way. This used to be the state of affairs nearly all the rains, in fact except when the Irrawaddy water was at its very highest, when a flow the right way was caused. This has now been to some extent alleviated by a cut to bring the floating stream in at an angle, and nowadays we get more flow down stream over these shallows than we used to.

Further down the Myitmaka or Hlaing river there is not much difficulty, the most interesting feature being that the country becomes still more submerged and villages are found standing in this water with no dry land within miles of them. Such a locality gives the logs admirable chances of getting away into the bushes and hiding themselves, chances they are not slow to take if given the least opportunity and raftsmen are not on the alert. When the Irrawaddy falls, all this water drains off and with it go the rafts to depôt, during October and November. At high water they cannot go down, as for one thing the Irrawaddy water entering the Myitmaka in a large stream lower down, creates an adverse flow above that. Then the current below that point, swollen by much Irrawaddy water, is too fast and there is a railway bridge to dodge as well as the job of pulling up every night.

The management of the logs after leaving the shallows has now been taken off the contractors' shoulders, and this leaves them more free to work in the jungles, and does not give them so many petty sub-contractors to finance at a time when money is short.

E. V. ELLIS.

THARRAWADDY:
23rd September 1911.

A NEW SPECIES OF MILDEW.

This is being called new not because it has been now noticed for the first time, but because it has been now for the first time scientifically identified. It was first noticed by the writer in 1896 on teak leaves in the dry teak forests of Rehli Range in the Saugor Division of the Northern Circle, C. P., and also in the adjoining forests of the Damoh Division. By the next year it had spread in all the teak forests of the Saugor Division. The writer of course does not know when it was first noticed elsewhere, but since then he has seen it in the forests of several divisions of the Northern and Southern Circles of the C. P. in Berar, and also in the forests of Bhopal State. Thus it appears to have spread over the whole of the Central Provinces and Berar, and parts of Central India. It would, however, be very interesting to learn how far it has actually spread, and if it was noticed anywhere else earlier.

This fungus attacks only the upper surface of teak leaves, and generally spreads over all the trees of the same species in the same forest without an exception giving a characteristic bluish appearance to the trees. Isolated trees however, at long distances from any infected area, have been found attacked. The attack, though so widespread, does not appear to do any practical damage to the trees attacked, as it has been often and often noticed that it neither caused any appreciably earlier fall of the leaves, nor any earlier appearance of a new flush of leaves, and so this cannot be expected to have in any way affected or retarded the growth of the trees attacked. It is, however, probable that it interferes to some extent with the assimilative power of the chlorophyll by partially cutting off the light.

It was perhaps for this, though the attack is so very conspicuous, making the leaves look as if coated with a dull whitewash, that no particular notice was taken of it so long, and because it was so very common and widespread that it was believed to be a known fungus.

In the touring season of 1906-07 the writer noticed for the first time in the forests of the Jubbulpore Division that the leaves of *Cordia Macleodii* were attacked apparently by the same fungus

and exactly in a similar manner, *i.e.*, the upper surface of the leaves of this species of tree was attacked as used to be the case with teak only up to this time, but of no other species at all. This led him to make some investigations, and it was noticed that the trees attacked did not suffer the least damage, as was the case with teak also. As the writer could only make observations and no examinations with microscopes, he brought this fact to the notice of his Conservator, and under his instructions forwarded specimens of affected leaves both of teak and *Cordia Macleodii* to Dr. E. J. Butler, the Imperial Mycologist at Pusa, who very kindly had the fungus identified. Then it was found that it was the same fungus that attacks the two different species of trees, and that it had not been identified before.

Dr. Butler had suggested that the writer should write a note on this subject, but it had been laid aside till interest in it was again aroused by noticing its attack on teak but not on *Cordia Macleodii* in the Amraoti Division of Berar, during the current touring season. It is interesting to note that during the last 15 years in which the fungus has spread over a large extent of country, it apparently has attacked only one other species besides teak, and that also apparently over limited areas.

Below is given a copy of D. O. No. 333, dated the 14th March 1908, from the Imperial Mycologist, to the address of the writer with a description of the fungus :—

"I beg to thank you for the beautiful set of specimens of mildew on teak and *Cordia Macleodii*, sent with your letter No. G-2742 dated Jubbulpore, 10th instant.

"These specimens have enabled me to determine that the mildew is identical on both host plants and is *Uncinula Tectonæ*, Salmon.

"As it might be of interest to other Forest Officers if you were to write a note on this new parasite in the *Indian Forester* or elsewhere, I attach an extract from a paper on 'Notes on some species of *Erysiphaceæ* from India' by Mr. E. S. Salmon (who is probably the chief authority on the mildews), published in the Annales Mycologici, December 1907."

Extract from Mr. E. S. Salmon's "Notes."

In November last Dr. E. J. Butler sent me some excellent specimens of an *Uncinula* with the following remarks:—" I recently obtained what appears to be an interesting *Uncinula* on teak, a host I cannot find mentioned for this genus. It appears to do a good deal of damage to teak in Central India, but I have only one leaf, of which I send you part. I cannot identify it with any of the known species." An examination of the material convinced me of the correctness of Dr. Butler's view that we had here a new species of the genus. I give below the diagnosis which I have drawn up from the specimens sent.

Uncinula Tectonæ, sp. Nov.—Epiphyllous; mycelium persistent, thin, effused; perithecia subgregarious, hemispherical, small, about 110" in diameter, cells 10—15" wide; appendages numerous, 75 to 100 in number, from slightly less than to slightly exceeding the diameter of the perithecium, often unequal in length in the same perithecium, delicate, hyaline, aseptate, usually thin-walled throughout but sometimes becoming thick-walled and opaque in the lower half, 5—6" wide towards the base, slightly attenuated upwards and about 4" wide, apex closely uncinate, sometimes helicoid, asci 4 to 9 small, broadly ovate, with a short distinct stalk, 65—70 × 38—40" ascospores 6—8, rarely only 4, crowded in the ascus, about 25 × 14."

Hab. India, Jubbulpore (Central Provinces). On *Tectona grandis*, July 1st, 1907. Collected by the Divisonal Forest Officer.

Distinct among the species of the genus possessing delicate appendages narrowed upwards in the number and the length of the appendages.

A. L. CHATTERJI.

AMRAOTI CAMP,
BERAR.

REPORT ON FOREST ADMINISTRATION IN THE INDORE STATE FOR THE YEAR 1910.

The area of reserved forests in the Indore State at the close of the year amounted, as far as can be gathered, to between 3,300 and 3,400 square miles, but as surveys are not yet completed, and no area statement appears among the appendices to the report, the exact area is not ascertainable. It would be well, when the correct areas of different reserved forests are finally determined, to include a detailed area statement in the annual report.

Surveys and demarcation have made good progress, and when they have been brought to a sufficiently advanced state we hope to see a corresponding progress in the preparation of working-plans where these are necessary. The State contains four Forest Divisions, but in only one, the Indore Division, are working-plans in force, the total area concerned being 444 square miles. Steps are being taken for the compilation of further plans, and we may hope for reasonable progress in the future. An appendix statement showing progress in working-plans, which does not exist at present, would greatly facilitate reference.

The disposal of cases in court appears to give some trouble, for although a Forest Bill was sent up by the Conservator to Council for sanction five years ago, it is still unpassed. This is surely not to the credit of the Council or the machinery of the State, for without a Forest Act to legalise matters it is impossible to effect any real progress in the organisation and control of the forests. Regarding cases pending at the close of the year, one Divisional Officer says : "In this connection I have to mention that having no Forest Law, to obtain convictions on circulars, which we have to bring within the meaning of sections in the Indore Penal Code, is next to impossible, even when the Magistrate has some knowledge of the circumstances existing in the forests, and this I regret to say is most exceptional." It is to be hoped that this unsatisfactory state of affairs will be remedied without delay.

Good results were attained in fire-protection considering the difficulties experienced. Out of 2,136 square miles attempted, 164

square miles were burnt, representing about 92 per cent of success. The large areas of hilly country, often covered with tall, rank, dry grass, the scarcity of water and the sparseness of the population, render the fighting of fires a difficult matter. The cost of protection was from Rs. 6-2-0 to Rs. 6-14-0 per square mile where complete protection was undertaken, and considerably less where the protection was only partial.

The dying of teak poles, noticeable for years past in the Warla forests, is reported to be still very prevalent, the poles dying before they attain any considerable girth. Coppice reproduction of teak, as well as reproduction by root-shoots, is reported to be good, the coppice-shoots attaining a height of 9 feet in six months on good soil in the Indore Division. Teak sowings have generally resulted in failure, while transplants both of teak and of Anjan are reported to have succeeded well.

Experiments in the propagation of lac have been in operation for nearly three years, but in most localities they have met with small success. The reasons for failure are believed to be climatic.

The financial results of the year are more satisfactory than they have been in previous years, the gross revenue being Rs. 3,27,899, the expenditure Rs. 1,69,044, and the surplus Rs. 1,58,855 as compared with Rs. 1,17,477 for the previous year and an average of Rs. 73,274 for the past three years.

We have to thank the Conservator Mr. Biscoe, who is about to retire from the State service, for an interesting report. The progress of forest work during his tenure of office has been steady and useful, and we gather that no small measure of the success attained has been due to the encouragement given by the Minister Rai Bahadur Nanak Chand, C.I.E.

REPORT ON FOREST ADMINISTRATION IN THE TRAVANCORE STATE FOR THE YEAR 1085 M.E.

The area of reserved forests was reduced by 142 acres during the year, and stood at 2,324 square miles 312 acres at the close of the year. Forest settlement made little progress, owing, it is stated, to the slackness of the Division Peshkars entrusted with

the work: these officers have now been ordered by the Government to submit monthly progress reports of forest settlement carried out by them.

Working-plans operations are still in a backward state, only about 77 square miles being under sanctioned working-plans, while plans were under compilation for a further area of about 213 square miles, of which only 36 square miles were taken in hand during the year.

Satisfactory results were attained in fire-protection, about 11 square miles having been burnt out of a total of 1,808 square miles attempted; this result is said to be due to improvement in precautionary measures.

Various works of artificial reproduction were carried out and thinnings in plantations received due attention. Judging by the amount spent on works of improvement in natural forest, however, little seems to have been done. Climbers were cut but the area operated over is not mentioned, and improvement fellings in the interests of the growing stock appear to have been carried out on an inadequate scale.

The gross revenue and expenditure of the year were Rs. 8,68,716 and Rs. 6,47,462 respectively, leaving a surplus of Rs. 2,21,254, which is Rs. 54,046 less than in the previous year, a deficiency explainable by a poor floating season consequent on the belated monsoon.

LIVING TELEGRAPH POLES.

Telegraph poles that live and grow are a curiosity of African engineering. In Uganda a species of wild fig, locally known as the bark cloth tree, is used for poles, and ten years or more ago it was noticed that they took root and began to send out leaves and branches soon after being planted. Since then a line of more than 500 miles of these growing poles has been developed. It is troublesome to maintain, as the leaves cause frequent leakage by contacts and poles are constantly dying and being eaten by termites. The first cost, however, is only 8 to 16 cents per pole, while an iron pole costs $5 to $7 or $8.—[*Capital.*]

NEGLECTED RUBBERS.

HOW "HEVEA" HAS OUSTED ALL THE OTHER VARIETIES.

Possibilities in the Middle East.

The *Financier* of September 4th had the following article upon the preponderance of Hevea cultivation and the prospects of other varieties of rubber :—

The magnitude of the interests now bound up in the successful cultivation of *Hevea Brasiliensis* in the Middle East and elsewhere alone furnishes justification, if such is really called for, of the apparent neglect to which other varieties of rubber-yielding trees have been subjected by the great majority of the world's planting communities. The selection of Hevea by the Middle East planter as the tree for his purpose may have been the combined result of unswerving belief in its possibilities and vicarious experiments in the tentative handling of the few available varieties. It was found, however, that, in the early days, at any rate, of the industry, the cultivation of Hevea constituted the basis of enterprises which could be carried on with less risk of failure from the standpoint of profits than any other cultivation in connection with alienated or non-alienated varieties of rubber trees. In the then state of knowledge as to Hevea's requirements, any attempt to have indulged in what might be termed universal rubber cultivation might have been to court disaster of an over-whelming character. On the principle that it is better to do one thing as well as it can be done than attempt a double task simultaneously and perform both only indifferently well and possibly very badly, the planting communities in the Middle East acted, in our humble opinion, very wisely when they decided to specialise in the matter of Hevea cultivation. Without such specialisation, and no doubt in a very large measure without the assistance of the very able body of scientists who early directed their attention, their knowledge and their energy to perfecting Hevea cultivation at the earliest possible moment, the great plantation industry in the Middle East would have been in a very different position from that which it holds without question to-day. The most ardent believers in its future are among the first to deny that perfection has been reached as

yet in the matter of plantation practice. But working along the lines they have done, the Middle East planters certainly have succeeded in avoiding anything resembling disaster in the past, and do not appear to have laid the foundations for any possible catastrophe of magnitude in the future.

" FICUS " IN MALAYA.

In achieving this end it has been necessary to very largely overlook the claims of other rubber varieties for consideration from the one and only standpoint it is possible to consider such claims—namely, that of profit-earners in a resonably brief period of time between the planting up of areas under rubber and the arrival of the trees at maturity. In Malaya the earlier planters found on their opened-up properties the indigenous *Ficus elastica* in greater or smaller quantities. Some of these pioneers in rubber cultivation retained this growth for a time, induced to do so for the most part by the knowledge that the planters in the Dutch colonies, notably Java, had undertaken, under scientific direction, the cultivation of these species. Later, on what appeared to be positive proof that as a rubber yielder Ficus was in no way comparable with Hevea, and the circulation of the statement that these Ficus yields were obtainable only in annually decreasing quantities until they practically disappeared and the tree had to be rested for an indefinite period, the Malayan planters, almost to a man, decided to have nothing whatever to do with the cultivation, and proceeded to cut it out at the earliest possible moment. Knowing what we now know of some of the recently developed vagaries of Hevea in the matter of latex yield after the trees have been tapped for a few years, and the necessity of resting these trees for a certain number of months as an irreducible minimum, with the prospect in some particular instances of still longer rest periods to be faced it seems that in some ways over-haste has been shown by planters in getting rid of their indigenous Ficus. We remember, when referring to Professor Wallace's condemnation of *Ficus elastica,* adventuring the suggestion that this tendency towards systematic decrease in the latex yields of this variety might be countered by

adopting a policy of manuring the ground from or just prior to the date of the first tapping. What subsequently struck us was that possibly a too high ideal as to the tree's yielding powers during its first years of production had been set up, and there was even the possibility that in tapping Ficus in general conformity with Hevea tapping practices, the best methods of latex extraction were not being followed in this particular connection. Furthermore, there was the chance that Ficus required not only different methods of tapping but a longer time to reach commercial maturity. Under these circumstances the last-named possible objection ruled the variety out of court in competition with Hevea, which, until very lately, we have been consistently requested to consider as a tree which in the majority of instances would give us regularly increasing yields of latex year after year.

YIELDS OF HEVEA.

Events, as we have said, have shown us that this regularity of increase in yield cannot be regarded as definitely fixed, but on account of these recent failures of Hevea to give satisfactory yields, we have not yet heard of any serious proposal to cut these trees out and replace them with some other variety or perhaps some totally different cultivation. The *Ficus elastica* may deserve all the hard things that have been said of it by experts and others who have reported from time to time in the immediate past on its commercial value and prospects, and there may not be the slightest real analogy between its habit of giving decreasing yields and the recently-developed refusal of hitherto good yielding Hevea to respond satisfactorily to operations on the renewed bark areas. On the other hand, there may be an establishable analogy, and in such an event the cutting out of *Ficus elastica* in many districts of Malaya may have yet to rank in the history of cultivated rubber in the Middle East as one of those regrettable incidents which similar occurrences in some parts of Ceylon might furnish an interesting parallel.

We may have failed up to the present to develop Mr. Wicherley's enthusiasm for Ceara and its prospects when properly

planted in Ceylon, but we are far from being desirous of damping his enthusiasm or that of any other competent worker in this particular field of inquiry. Like *Ficus elastica* in Malaya, Ceara Rubber in Ceylon, given that it was at all properly planted, under satisfactory soil and climatic conditions, always has grown well. It was when it came to tapping the Ceylon Ceara so that the trees were not perished as the result of the first operation or so that the trouble with this variety arose. When we recall the atrocities in connection with tapping Hevea on many Middle East rubber estates, and remember that but for the specalisation with regard to this cultivation, to which reference has just been made, these atrocities still might be prepetrated, we find, perhaps, the most satisfactory ground for hoping that there is a sound commercial future for the Ceara varieties in Ceylon and Southern India. The rubber produced under existing tapping methods is good rubber, and when carefully prepared fetches good prices when sold at the London plantation rubber auctions. A tapping system, which Mr. Wicherey claims to have discovered, calculated to give the close-planted and rapid-to-mature Ceara a reasonable commercial life, means nothing more or nothing less than the conversion of large areas at present under this variety in Ceylon from uselessness to very profitable utility. The best tapping system which Mr. Wicherley or any other practical expert can evoke may fail to give the trees that period of life which would put them on the basis we have just indicated. But in attempting to decide, for business purposes, the extent of this period it might be well to *ignore analogies* obtainable from Hevea under cultivation. We have got to arrive at the time when we will regard, in a general way, 100 matured Hevea to the acre as representing rather close planting, and we may possibly have to overhaul our ideas as to what constitutes the age at which the trees, regarding them in the light of permanent profit-earning assets, can be systematically tapped. We have, however, in Ceara a rubber tree non-indigenous to the Middle East which matures with great rapidity, and can be grown with apparently perfect safety many hundreds to the acre. The problem, then, comes up as to whether one or two successful

tappings might not be regarded as representing the satisfactory commercial life of the tree, after which it could be cut down, the roots removed and these areas replanted, while from other sections of the properties income would be steadily earned from the already matured trees. We might even get along to the suggestion of an old reader of ours that, as Ceara can be brought to apparently sufficient maturity in 18 months or so no more than one season's tapping should be expected from the trees, which would then be cleared away and the procedure just outlined pursued by the estate owner. This is a matter into which we may have occasion to go more deeply in the near future, but in the meantime we wish to emphasise the opinion that we ought, when attempting any commercial plantation valuation of Ceara, to exercise exceeding care in the choice of the basis which upon such a valuation is constructed—[*Straits Budget.*]

THE LEGEND OF THE RAIN-TREE.

During the last few months American newspapers have received the well-worn tale of the "Peruvian rain-tree" which affords protection against drought. The leaves of this tree are said to have the property of condensing atmospheric moisture in large quantities and precipitating it in the form of rain. According to one writer, "the water falls from the leaves and oozes from the trunk and forms veritable rivers, which can be led as irrigating canals to any point desired. Making liberal allowance for evaporation and infiltration, a square mile grove of the trees would supply for distribution about 100,000 gallons of water daily."

On the strength of similar stories one of the trees to which the name "rain-tree" has been most often applied, viz., *Albizzia* (or *Pithecolobium*) *saman*, has lately been exploited and sold extensively in Australia. The virtues claimed for it have proved to be altogether illusory, although it is useful as a shade-tree, and is widely planted for this purpose in semi-tropical and tropical countries.

The legend of the "rain-tree" or "raining-tree" dates back to the stories of the Fortunate Isles, where no rain fell from the skies and the soil was refreshed by the moisture shed by a tree of the sort described. The early navigators brought home stories of similar trees in the East Indies, in Guinea, Brazil, etc. The Peruvian rain-tree appears to have been brought to the notice of the world by the reports of a United States Consul in Peru, about 1877. These reports were widely quoted at the time, and led the Government of India to seek information on the subject from the authorities of Kew Gardens. The investigations of W. T. Thistleton Dyer brought to light a plausible explanation of at least a part of the rain-tree stories.

The traveller Spruce reported his own experiences with the rain-tree as follows:—

"The Tamia-caspi, or rain-tree of the eastern Peruvian Andes, is not a myth, but a fact, although not exactly in the way popular rumour has lately presented it. I first witnessed the phenomenon in September 1855, when residing at Tarapoto. I had gone one morning at daybreak, with two assistants, into the adjacent wooded hills to botanise. A little after seven o'clock we came under a lowish spreading tree, from which with a perfectly clear sky overhead a smart rain was falling. A glance upward showed a multitude of cicadas sucking the juices of the tender young branches and leaves, and squirting forth slender streams of limpid fluid."

This is not the only explanation. That many plants spontaneously exude moisture under suitable conditions is well known. The phenomenon is called "guttation," and has perhaps been most fully described by A. Burgerstein in his work "Die Transpiration der Pflanzen" (Jena, 1904). The moisture drawn up from the roots of plants most frequently passes off into the air in a gaseous form, *i.e.*, by transpiration. If the air is saturated with moisture, and if the supply of moisture to the roots is copious, then liquid drops will be exuded sometimes in large quantities. Molisch records a case in which a single leaf of a species of *Colocasia* gave off 190 drops per minute. Burgerstein gives a list of 241 plants, belonging to 101 families, in which guttation has been observed.

This process goes on chiefly at night, and in cloudy and foggy weather, *i.e.*, when the relative humidity of the air is highest. It is altogether probable that in the moister parts of the tropics there are trees which exhibit this phenomenon in such a degree that the name "rain-tree" may be fittingly applied to them. It is, however, certain that no such process can occur in a dry climate, and that the proposal to plant the rain-tree as a panacea against drought is entirely chimerical.—[*Scientific American.*]

LATEST GOVERNMENT ORDERS REGARDING PRIVATE EMPLOYMENT TAKEN UP BY OFFICERS ON LEAVE.

No. 5471-*C. S. R., Government of India, Finance Department.*

RESOLUTION.

Simla, the 6th September 1911.

READ—

Resolution by the Government of India in the Finance Department, No. 2998-P., dated the 16th May 1907.

Despatch from His Majesty's Secretary of State, No. 91-Public, dated the 18th June 1909.

The Government of India consider it desirable to call attention to the orders of the Secretary of State for India requiring officers on leave out of India to obtain his sanction before taking up private employment. They have further decided to extend the authority granted to Local Governments in the Resolution above cited to permit officers on leave to accept employment outside Government service. The Governor-General in Council is accordingly pleased to revise as follows the orders contained in that Resolution.

2. The Government of India desire to repeat that inasmuch as leave is intended as a period of recreation and rest and is granted to an officer for the purpose of recruiting his health, it follows that taking up employment during leave is not permissible save in exceptional circumstances and with special sanction.

3. A gazetted officer who is in receipt of furlough or leave allowances must obtain, if he is resident out of India, the previous

sanction of the Secretary of State or if resident in India, that of the Local Government, or (if he is serving under the Government of India) of Government of India, before taking service under an employer other than Government or accepting any employment not being under Government, which involves the receipt of a fee or honorarium.* In the case, however, of a non-gazetted officer resident in India the special permission of the officer empowered to appoint him may be accepted as sufficient authority.

4. The orders contained in the preceding paragraphs refer to the acceptance of employment of any description whatever, not being employment of the kind for which the Foreign Service Rules in Part VII of the Civil Service Regulations provide. An officer in receipt of leave allowances cannot take up an appointment which is such as should, for public reasons and not merely in his own interest, be filled by a servant of Government, unless he has been transferred thereto in the regular way by the authority empowered to authorise his transfer under the rules regulating transfers to Foreign Service. An officer who has been so transferred ceases, from the date on which he takes up the appointment, to be on leave and is no longer entitled to draw leave allowances from Government. He becomes an officer in active service drawing from his employer pay fixed in accordance with rule.

Order.—Ordered that this Resolution be communicated to all Local Governments and Administrations, to the several departments of the Government of India, to the Heads of Departments subordinate to the Finance Department, to the Comptroller and Auditor-General, and to all Accountants-General and Comptrollers, Examiners and Government Examiners of Railway Accounts, and the Examiner of Accounts, Military Works Services, for information.

Ordered also, that this Resolution be published in the Gazette of India.

(Sd.) J. S. MESTON,
Secretary to the Government of India.

* NOTE.—This condition is not to be held to apply to the receipt of fees for literary work, or for service as an Examiner, or to simila employment.

AMENDMENT TO THE INDIAN FOREST ACT.

GOVERNMENT OF INDIA, LEGISLATIVE DEPARTMENT.

The following Act of the Governor-General of India in Council received the assent of the Governor-General on the 18th September 1911, and is hereby promulgated for general information :—

ACT NO. XV OF 1911.

An Act further to amend the Indian Forest Act, 1878.

Whereas it is expedient further to amend the Indian Forest Act, 1878 *; It is hereby enacted as follows:—

Short title.

1. This Act may be called the Indian Forest (Amendment) Act, 1911.

Amendment of section 2, Act VII, 1878.

2. In section 2 of the Indian Forest Act, 1878, in sub-clause (*a*) of the definition of "forest-produce," after the words "mahua flowers" the words "mahua seeds" shall be inserted.

Amendment of section 26, Act VII, 1878.

3. In section 26 of the said Act, for the words "with the previous sanction" the words "subject to the control" shall be substituted.

Amendment of section 31, Act VII, 1878.

4. In section 31 of the said Act, after the words "from time to time" the words "and subject to the control of the Governor-General in Council" shall be inserted.

Amendment of section 39, Act VII, 1878.

In section 39 of the said Act—

(*a*) for the words "with the previous sanction" the words "subject to the control" shall be substituted;

(*b*) after sub-clause (*b*) the following proviso shall be inserted, namely :—

"Provided that a notification directing the levy of a duty in the case of timber and other forest-produce brought, from any place beyond the frontier of British India, which is not under the control of the Local Government, shall not be issued without the previous sanction of the Governor-General in Council"; and

* VII of 1878.

(*c*) for the words "with the like sanction" the words "subject to the like control or sanction, respectively," shall be substituted.

Repeal of proviso to section 77, Act VII, 1878.

The proviso to section 77 of the said Act is hereby repealed.

CORRESPONDENCE.

VOLUME XXXVIII NUMBER 2

INDIAN FORESTER

FEBRUARY, 1912.

[*Circular No. 27-F.-267-3, Government of India, Department of Revenue and Agriculture, (Forests), dated Simla, the 23rd October* 1911.]

INDIAN FOREST SERVICE.

REGULATIONS AS TO THE APPOINTMENT OF PROBATIONERS, 1912.

1. *Appointments.*—The Secretary of State for India in Council will, in the summer of 1912, make *not less than five appointments* of Probationers for the Indian Forest Service, provided that so many candidates are considered to be in all respects qualified.

In making these appointments, he will act with the advice of a Selection Committee.

2. *Applications for Appointment.*—Applications for appointment must be made on a printed form to be obtained from the Secretary, Judicial and Public Department, India Office, Whitehall, London, S. W., and to be returned to him not later than *Monday, the 1st July* 1912. Candidates must be prepared, if called upon, to attend at the India Office, at their own expense, for a personal interview with the Selection Committee within three weeks from that date.

3. *Age Limit.*—Candidates must be not less than 19 but under 23 years of age on the 1st July 1912.

Notice is hereby given that the age limits for the recruitment of 1913 *and following years will be* 19 *and* 22 *years on the* 1*st* January *of the year in which the selection is made.*

4. *Nationality, etc.*—Every candidate must be a natural-born British subject. He must be unmarried, and if he marries before he reaches India he will forfeit his appointment. He must be of good physique, and must produce evidence of character to satisfy the Secretary of State for India in Council that he is suited for the Indian Forest Service.

5. *Qualifications.*—Candidates must be able to show that in addition to having received a good general education they have passed with honours in a public examination for a degree in some branch of Natural Science held by a University in Great Britain or Ireland. A good general education should be understood to include, at the least, a fair knowledge of English Composition, Mathematics up to and including Plane Trigonometry, and either German or French. The production of school certificates granted by the examining authorities of Universities, or of certificates that a candidate has passed the Matriculation Examination of a University, in the subjects named, or of other certificates held by the Secretary of State in Council to be equivalent, will be taken to show that a candidate satisfied the requirements of this clause.

6. Should there be more candidates considered to be qualified in every respect than vacancies to be filled, the Secretary of State reserves the right to require them to pass a competitive examination conducted by the Civil Service Commissioners, on the result of which their final selection would depend. Particulars of this examination, which would be held in August, will be found in Appendix I.

7. *Medical Examination.*—Selected candidates will be required to undergo a strict examination by a Medical Board at the India Office, at which particular stress will be laid on good vision and hearing, and to satisfy the Secretary of State for India that

they are physically fit for service in the Indian Forest Department (*see* Appendix V).

Candidates who do not satisfy the Secretary of State for India that they are physically fit for appointment to the Indian Forest Service will not be admitted to the competitive examination mentioned in Regulation 6.

8. *Period of Probation.*—The ordinary period of probation will be two years. During that time probationers will be required to pass through the Forestry course at one of the Universities named below * becoming members of that University if not so already; to obtain the Degree or Diploma in Forestry which it grants; to acquire some knowledge of Hindustani; and to satisfy such other tests of proficiency as may be deemed necessary. The case of students who have already obtained such degree or diploma at any of the above-named Universities will be specially considered in each case.

During the vacations the probationers will, under the direction and supervision of the Director of Indian Forest Studies appointed by the Secretary of State for India in Council, receive practical instruction in such British and Continental forests as may be selected for the purpose.

9. *Charges.*—The probationers will be required to defray all expenses of lodging, board, tuition, and excursions, while at the University, and on practical instruction in Britain and on the Continent, with the exception of fees payable to local Forest Officers in Britain and on the Continent.

10. *Allowances.*—The Secretary of State for India in Council will make payments to each probationer at the rate of 120*l* annually, not exceeding a total of 240*l*. (besides the fees to local officers mentioned above). These payments will ordinarily be made on the following dates in each year :—

				£
On the 1st December	...	...	...	30
On the 1st March	...	...	...	30
On the 1st June	...	...	...	60

* Oxford, Cambridge, Edinburgh.

The cases of probationers whose probation does not extend over the full two years will be specially considered.

The grant of the allowances is subject to the following conditions :—

(*a*) that the progress of the probationer in his studies satisfactory ;

(*b*) that the probationer gives security to refund the payments in case he fails to join the Indian Forest Service at the end of the period of probation.

11. *Conduct.*—Every probationer will be required to conduct himself during the period of probation in a manner satisfactory to the Secretary of State, and to give evidence of satisfactory progress in his studies in such a manner as may be required, failing which, or in the event of serious misconduct, he will be liable to have his name removed from the list of probationers.

12. *Appointment and Seniority.*—Probationers who obtain a Degree or Diploma in Forestry, and are of sound constitution and free from physical defects which would render them unsuitable for employment in the Indian Forest Service, will be appointed Assistant Conservators in the Indian Forest Department. Their position in the Provincial Forest Lists will be determined by the Secretary of State for India in Council on the Report of the Director of Indian Forest Studies ; but in making selections for the post of Conservator, officers joining the service in the same year are reckoned as equal in seniority, unless the Secretary of State for India in Council shall for special reasons have directed otherwise in any particular case or cases.

They will be allowed at the end of the period of probation to state their preference in respect to the Provinces to which they desire to be allotted ; but the distribution will be made to the several Provinces according to the needs of the public service, at the discretion of the Secretary of State for India. Officers are, however, at all times liable to be transferred from one Province to another at the pleasure of the Government of India.

13. *Riding.*—Every probationer, before proceeding to India, will be required to satisfy the Secretary of State, in such manner as may be determined, of his ability to ride.

14. *Articles of Agreement.*—Within a month of his nomination as Assistant Conservator, each nominee must sign articles of agreement describing the terms and conditions of his appointment; he must embark for India when required to do so by the Secretary of State, and must engage his own passage. Failure to embark at the stated time will, in the absence of satisfactory explanation, lead to forfeiture of appointment.

15. *Salary.*—An Assistant Conservator of Forests will draw pay at the rate of Rs. 380 a month (equivalent to 304*l.* a year, when the rupee is at 1*s.* 4*d.*) from the date of his reporting his arrival in India.

16. *Promotion, Leave, Pension, and Provident Fund.*—Promotion, leave, and pension will be governed by the Regulations laid down by the Government of India, and applicable to Forest Officers, such regulations being subject to any modifications or alterations which may be made in them from time to time by the Government of India, and their interpretation in case of any doubt arising being left to that Government. A copy of the existing regulations can be seen on application at the India Office.

Certain information regarding appointments in the upper controlling staff of the Indian Forest Service, the pay of which has been recently improved, will be found in Appendix II; a summary of information regarding Leave is contained in Appendix III; and regarding Pensions and the Provident Fund in Appendix IV.

INDIA OFFICE:
29th August 1911.

APPENDIX I.

COMPETITIVE EXAMINATION.

In the event of the Civil Service Commissioners being requested by the Secretary of State for India in Council to hold an examination in any year of candidates nominated by him to compete for appointment as probationers for the above Service, the following will be the subjects in which such candidates will be examined:—

1. English Composition.	4. Physics.
2. German *or* French.	5. Geology.
3. Chemistry.	6. Botany.

7. Zoology.

Not more than two of the subjects numbered 4 to 7 may be offered.

Candidates must pass to the satisfaction of the Civil Service Commissioners in the first three subjects.

In the subjects numbered 3 to 7, only marks showing real attainment will be counted towards the order of merit, so that a candidate who has a thorough knowledge of one of the optional subjects may obtain on that subject alone as many marks as a candidate who offers two of the optional subjects on a lower standard.

SYLLABUS.

Languages.—The examination in German and French will include translation, composition, and conversation.

Sciences.—The standard of the examination in Chemistry, Physics, Geology, Botany, and Zoology will be that of the Honours Schools of the Universities.

APPENDIX II.

LIST OF APPOINTMENTS OPEN TO MEMBERS OF THE IMPERIAL BRANCH OF THE INDIAN FOREST SERVICE.

[NOTE.—This list is liable to alteration at any time.]

	Appointment.	Rs.	Salary.
1	Inspector-General of Forests ...	2,650	a month.
*1	Assistant Inspector-General of Forests.	——	
2	Chief Conservators (Burma and Central Provinces).	2,150	"
20	Conservators in three grades ...	1,900	" respectively.
		1,700	"
		1,500	"

The appointments of Conservator and Deputy and Assistant Conservator are allotted to the various provinces as follows :—Burma, 65 ; Madras, 28 ; Bombay, 27 ; Central Provinces, 24 ; Bengal, 11 ; United Provinces, 19 ; Punjab, 12 ; and Eastern Bengal and Assam, 18.

* The officer holding this appointment draws in addition to the pay of his grade a minimum local allowance of Rs. 200 a month.

184 Deputy and Assistant Conservators. 5 Foreign Service appointments. †6 Officers employed at the Forest Research Institute and College, Dehra Dun.	*Rs. 380 a month, rising by annual increments of Rs. 40 a month to Rs. 700 a month; thereafter, by annual increments of Rs. 50 a month to Rs. 1,250 a month, in the twentieth year of service.

APPENDIX III.

(See paragraph 16 of the Regulations.)

LEAVE.

1. The following is a summary of the principal regulations relating to the leave admissible to officers appointed to the Indian Forest Service by the Secretary of State from the United Kingdom.

Long leave.

2. Furlough and special leave with allowances (*see* paragraph 6) are admissible to an aggregate maximum amount of six years during an officer's service. The amount of furlough "earned" is one-fourth of an officer's active service, and the amount "due" is that amount less any enjoyed.

3. Furlough without medical certificate can, if due, be generally taken after eight years' active service, and again after intervals of not less than three years' continuous service. It is limited to two years at a time.

4. Furlough on medical certificate may be granted (*a*) to an officer who has rendered three years' continuous service, for not more than two years, but capable of extension up to three years; and (*b*) to an officer who has not rendered three years' continuous

* Until he has passed the prescribed Departmental examinations, an Assistant Conservator may not draw pay at a higher rate than Rs. 460 a month. On passing the examinations he will resume drawing pay under the time scale at the rate to which his length of service entitles him.

† These draw a local allowance of Rs. 150 a month in addition to their grade pay, with the exception of the Principal of the College, in whose case the allowance is at the rate of Rs. 200 a month.

NOTE.—Under the improved scale of salary shown above, no Exchange Compensation Allowance is granted.

service up to one year in any case, and up to such longer period, if any (but not exceeding two years in all), as the officer may have furlough "due" to him.

5. The allowances admissible during furlough are :—

(1) During the first two years of furlough without medical certificate and during so much of furlough with medical certificate as may be "due"—half average salary, subject to certain maximum and minimum limits.

(2) After the expiration of the period for which the foregoing allowances are admissible—one quarter of average salary, subject to certain maximum and minimum limits.

6. Special leave may be granted at any time for not more than six months, with intervals of six years' service ; allowances, calculated as during furlough, are given during the first six months only, whether taken in one or more instalments.

Short leave.

7. Privilege leave is a holiday which may be granted to the extent of one-eleventh part of the time that an officer has been on duty without interruption ; and it may be accumulated up to three months, earned by 33 months' duty. During privilege leave, the officer retains a lien on his appointment, and receives the salary which he would have received if on duty. An interval of not less than six months must elapse between two periods of absence on privilege leave.

Privilege leave may be prefixed to furlough, special leave, or extraordinary leave without allowances. The whole period of leave thus taken in combination is known as combined leave. Combined leave may not be granted for a period of less duration than six months, nor, except on medical certificate, may it be extended beyond two years.

8. Subsidiary leave in India for a minimum of ten days, usually with half average salary, is granted to an officer proceeding on or returning from leave out of India, or on retirement, to enable him to reach the port of embarkation or to rejoin his appointment. It

is admissible only at the end and not at the beginning of combined leave.

9. Short leave is also granted to enable officers to appear at examinations, etc.

10. Extraordinary leave without allowances may be granted in case of necessity, and, except in certain specified cases, only when no other kind of leave is by rule admissible. It may be granted in continuation of other leave.

General Rules.

11. Leave of absence, whether on furlough or on privilege leave, can never be claimed as of right, and is given or refused at the discretion of Government.

12. After five years' continuous absence from duty, an officer is considered to be out of the employment of Government.

13. When leave allowances other than privilege leave pay are paid at the Home Treasury, or in a Colony where the standard of currency is gold, rupees are converted into sterling at the rate of exchange fixed for the time being for the adjustment of financial transactions between the Imperial and Indian Treasuries, unless any other rate has been exceptionally authorised. But for the present the rate of conversion is subject to a minimum of 1*s.* 6*d.* to the rupee. Privilege leave pay when issued from the Home Treasury (this is only admissible when privilege leave is combined with other leave) is converted at 1*s.* 4*d.* to the rupee.

APPENDIX IV.

(*See paragraph* 16 *of the Regulations.*)

PENSIONS AND PROVIDENT FUND.

1. The following is a summary of the principal pension rules applicable to officers of the Indian Forest Service appointed by the Secretary of State from the United Kingdom :—

An officer of the Indian Forest Service is eligible for a pension on voluntary retirement after completing 20 years' qualifying service or attaining the age of 55 years. If at an earlier date he is compelled to retire from the service through ill-health, not occasioned by irregular or intemperate habits, he becomes eligible

for an invalid pension or a gratuity according to the length of his service.

The amount of pension or gratuity is regulated as follows :—

After a service of less than 10 years, an invalid gratuity not exceeding one month's emoluments for each completed year of service.

After a service of not less than 10 years an invalid pension not exceeding the following amounts :—

Years of completed service.	Maximum limits of pension.
	Rs.
10	1,000 a year.
11	1,400 ,,
12	1,800 ,,
13	2,200 ,,
14	2,600 ,,
15	3,000 ,,
16	
17	
18	
19	

After a service of not less than 20 years, a retiring pension not exceeding the following amounts :—

Scale of pension.

Years of completed service.	Sixtieths of average emoluments.	Maximum limit of pension.
		Rs.
20 to 24	30	4,000 a year.
25 and above		5,000 ,,

Officers who have shown special energy and efficiency during an effective service of three years as Inspector-General of Forests or Conservator may, at the discretion of the Government of India, be allowed an additional pension of Rs. 1,000 a year, subject to the condition that the officer must not retire voluntarily before the completion of a total qualifying service of 28 years.

Subject to certain prescribed conditions, rupee pensions are now issued to pensioners residing in countries where the Indian rupee is not legal tender at the rate of exchange of 1*s*. 9*d*. the rupee.

2. A General Provident Fund has also been established on the following basis :—

(*a*) The contribution is compulsory up to 6¼ per cent on salaries, with voluntary contributions of not more than a further 6¼ per cent. Subscriptions on leave of any kind are optional ; other forms of life insurance will, if they fulfil certain conditions, be accepted in lieu of such contribution.

(*b*) Compound interest on such payments is annually credited by Government to each officer subscribing, the rate being at present 4 per cent per annum.

(*c*) The sum which will thus accumulate to the credit of an officer to be his absolute property, to be handed over to him unconditionally on quitting the service ; or, in the event of his death before retirement, to his legal representatives.

APPENDIX V.

GENERAL PHYSICAL REQUIREMENTS.

Note.—These Regulations are published for the convenience of candidates and in order to enable them to ascertain the probability of their coming up to the required physical standard. But it must be clearly understood that the Secretary of State reserves to himself an absolute discretion to reject as unfit any candidate whom he may consider, after hearing the opinion of his medical advisers, to be physically disqualified for the public

service; and that his discretion is in no respect limited by these Regulations.

1. A candidate must be in good mental and bodily health, and free from any physical defect likely to interfere with efficient performance of duty.

2. In the examination of candidates the Medical Board will apply the following table of correlation of age, height, and chest girth:—

Age.	Height without shoes.	Chest.	
		Girth when expanded.	Range of expansion.
	Inches.	Inches.	Inches.
19 to 20	62½ and under 65	35	2
	65 " 68	35	2
	68 " 70	35½	2
	70 " 72	36	2
	72 and upwards.	36½	2½
21 and upwards	62½ and under 65	35	2
	65 " 68	35½	2
	68 " 70	36	2
	70 " 72	36½	2½
	72 and upwards.	37	2½

3. *Measurement of Height.*—The candidate will be placed against the standard with his feet together, and the weight thrown on the heels, and not on the toes or outside of the feet. He will stand erect without rigidity, and with the heels, calves, buttocks, and shoulders touching the standard; the chin will be depressed to bring the vertex of the head level under the horizontal bar, and the height will be noted in parts of an inch to eighths. No fixed limit of height is imposed.

4. *Measuremnent of Chest.*—The candidate will be made to stand erect with his feet together and to raise his hand above his head. The tape will be carefully adjusted round the chest, the posterior upper edge touching the inferior angles of the shoulder blades, and its anterior lower edge the upper part of the nipples. The arms will then be lowered to hang loosely by the side, and

care will be taken that the shoulders are not thrown upwards or backwards so as to displace the tape. The candidate will then be directed to empty his chest of air as much as possible. This is best done by continuous whistling with the lips as long as sound can be produced. The tape is carefully gathered in during the process, and when the minimum measurement is reached it is recorded. The candidate will then be directed to inflate his chest to its utmost capacity. This maximum measurement will likewise be noted. The girth with the chest fully expanded and the range of expansion between the minimum and the maximum will then be recorded.

5. The hearing must be good.

6. The speech without impediment.

7. The teeth in good order, *i.e.*, decayed or broken teeth must be properly stopped or crowned, and deficient teeth replaced by artificial teeth where necessary for effective mastication.

8. The chest must be well formed, the lungs and heart sound.

9. Rupture, hydrocele, varicocele, varicose veins in a severe degree, or other condition likely to cause inefficiency will disqualify a candidate, unless such condition is cured by operation.

10. The limbs, feet, and toes must be well formed and developed, with free and perfect motion of all the joints.

11. A candidate must have no congenital malformation or defect likely to interfere with efficiency.

12. A candidate must not be the subject of chronic skin disease.

13. Evidence of previous acute or chronic disease pointing to an impaired constitution will disqualify.

14. Candidates may, not more than two years before they are qualified to compete for an appointment, undergo a preliminary examination by the Medical Board, which meets at the India Office every Tuesday, under the following conditions:—

(*a*) Applications must be addressed to the Under-Secretary of State, India Office, Whitehall, London, accompanied by a fee of two guineas and a statement of the candidate's age.

(*b*) Candidates must pay their travelling expenses.

(*c*) Candidates considered to be unfit by the Medical Board at this preliminary examination are not bound to accept its opinion, but may, *at their own risk*, continue their studies, with the knowledge that they will have to submit themselves for a final medical examination by the Medical Board, prior to their appointment.

(*d*) On the other hand, it must be distinctly understood that the preliminary examination by the Medical Board is held solely for the candidate's information, and that, if after that examination he is reported to be apparently fit, he has not on that account any claim to be accepted as physically fit when he presents himself for the final medical examination, upon which alone his acceptance or rejection will depend. Candidates may be considered fit for the service at the preliminary examination, but may be found at the final examination to be unfit, either on account of some physical defect which did not exist or passed undetected at the preliminary examination, or for other reasons.

REGULATIONS AS TO THE STANDARD OF VISION FOR THE INDIAN FOREST SERVICE.

1. If myopia in one or both eyes exists, a candidate may be passed, provided the ametropia does not exceed 2·5 D, and if with correcting glasses, not exceeding 2·5 D, the acuteness of vision in one eye equals $\frac{6}{9}$ and in the other $\frac{6}{6}$, there being normal range of accommodation with the glasses.

2. Myopic astigmatism does not disqualify a candidate for service, provided the lens or the combined spherical and cylindrical lenses required to correct the error of refraction do not exceed—2·5 D; the acuteness of vision in one eye, when corrected being equal to $\frac{6}{6}$, and in the other eye $\frac{6}{9}$, together with normal range of accommodation with the correcting glasses, there being no evidence of progressive disease in the choroid or retina.

3. A candidate having total hypermetropia not exceeding 4 D *is not disqualified, provided* the *sight* in *one eye* (when under the influence of atropine) equals $\frac{6}{9}$, and in the other eye equals $\frac{6}{6}$, with + 4 D or any lower power.

4. Hypermetropic astigmatism does not disqualify a candidate for the service, provided the lens or combined lenses required to cover the error of refraction do not exceed 4 D, and that the sight of one eye equals $\frac{6}{9}$ and of the other $\frac{6}{6}$, with or without such lens or lenses.

5. A candidate having a defect of vision arising from nebula of the cornea is disqualified if the sight of one eye be less than $\frac{6}{12}$. In such a case the better eye must be emmetropic. Defects of vision arising from pathological or other changes in the deeper structures of either eye, which are not referred to in the above rules, may exclude a candidate for admission into the service.

6. Squint, or any morbid condition, subject to the risk of aggravation or recurrence, in either eye, may cause the rejection of a candidate. The existence of imperfection of colour sense will be noted on the candidate's papers.

Ordered that a copy of the foregoing Regulations be forwarded, for information, to the Local Governments and Administrations noted in the margin, the Inspector-General of Forests and the Comptroller, India Treasuries. Also that the Regulations be published in the Supplement to the *Gazette of India*.

1. The Secretary to the Government of Madras, Revenue Department.
2. " Chief Secretary to the Government of Bombay, Revenue Department.
3. " Secretary to the Government of Bengal, Revenue Department.
4. " Chief Secretary to the Government of the United Provinces.
5. " " " " Punjab.
6. " Revenue Secretary to the Government of Burma.
7. " Financial Secretary to the Government of Eastern Bengal and Assam.
8. " Honourable the Chief Commissioner of the Central Provinces.
9. " Chief Commissioner of Coorg.
10. " " Ajmer.
11. " Honourable the Agent to the Governor-General and Chief Commissioner in Baluchistan.
12. " Honourable the Chief Commissioner and Agent to the Governor-General in the North-West Frontier Province.
13. " Superintendent of Port Blair.

E. D. MACLAGAN,
Secretary to the Government of India.

For Office use only.
No.
Ackd.

INDIAN FOREST SERVICE.

FORM TO BE FILLED UP BY CANDIDATES FOR APPOINTMENT AS PROBATIONER, 1912.

No person will be considered as a Candidate from whom the Secretary, Judicial and Public Department, India Office, Whitehall, London, S.W., shall not have received, on or before Monday, the 1st July 1912, *at latest, an application on this form.*

If Candidates who fill up and return the Application Form do not receive an acknowledgment of it within four complete days, they should communicate with the Secretary, Judicial and Public Department.

INDIA OFFICE.
August 1911.

1	Name in full.
2	Address. (*Any alteration to be notified to the Secretary, Judicial and Public Department, India Office, Whitehall, London, S.W.*)
3	Date and place of Birth. (*In the event of the Candidate's selection, he will be required to produce a Birth Certificate or other satisfactory evidence of age.*)
4	Profession or occupation, and nationality of Father.

5	The names of any near relatives who have been, or are now, in the service of the Indian Government, and the appointments at present, or immediately before retirement or decease, held by them.
6	All Institutions where educated, with dates, distinguishing whether or not the Candidate was in residence at such Institutions. *From* *to* *at* *From* *to* *at* *From* *to* *at* *From* *to* *at*
7	Whether trained at the public expense in any Training *College in England and Wales.*

8	The Candidate should insert here full information with regard to his qualifications, under paragraph 5 of the Regulations.
9	Whether married or single (*see* paragraph 4 of Regulations).
10	Names and addresses of three persons (of whom at least one should be connected with the Institution at which the Candidate has last studied) who will testify, if applied to, as to conduct and character during the last four years. (*References will not be accepted from persons who are related to or have no personal knowledge of the Candidate.*)
11	Whether the Candidate has previously applied, either in England or in India, for an appointment under the Government of India.

*Signature of Candidate*________________________

*Date*________________1912.

THE CALCULATION OF THE YIELD BY NUMBER OF TREES UNDER THE SELECTION SYSTEM.

In many Indian working-plans the yield by number of trees under the selection system is calculated by the formula $\frac{I + \frac{1}{2}II}{p}$

where I = No. of 1st class (*i.e.* exploitable) trees enumerated.

II = No. of 2nd class trees enumerated.

p = period of years for which the fellings are prescribed.

This general formula has often been indiscriminately applied, whatever the relation between the period of the working-plan, the felling cycle and the transition period (*i.e.*, time taken for a tree of the lowest dimensions of class II or III to reach the lowest dimensions of class I or II). This has been a somewhat fruitful source of error in the calculation of the yield, for the above formula is applicable only in one particular case, namely, where the felling cycle period of the working-plan and transition period are all equal [see formula No. (4) below]. With different variations in these three factors complicated formulæ of considerable length may be evolved, and it is therefore advisable, in the interests of simplicity, to fix them in such a way as to avoid the more complicated formulæ, while at the same time obtaining the highest possible yield compatible with practicability in working.

The number of different formulæ applicable to different cases is considerable, but for our purpose it will be sufficient to take 8 variations. The ideal case is where fellings go over the whole area every year, the maximum possible yield being thereby obtained. Except for very small areas, however, this is impracticable, and a felling-cycle extending over a series of years has to be adopted, during which fellings go completely over the area. This results in an accumulation of mature trees which have reached maturity in each coupe after the fellings have passed over it ; this accumulation constitutes an excess of mature trees which has to be kept on the ground, and may be regarded as so much working capital. The reduction of this excess to the minimum possible, so far as is compatible with practical working and simplicity, should be one of the chief aims in fixing the period and the felling cycle.

Apart from this excess we have, in our irregular Indian forests generally, a certain further excess in the shape of mature (I class) trees standing on the ground at the commencement of the period; these trees we may assume to be all removable except those retained for sylvicultural reasons.

In the 8 variations considered below, which comprise all those likely to be met with in ordinary practice as well as some of a more complicated nature, the general formulæ are evolved from concrete examples to make matters clearer, except formula (1) which is self-evident.

In the calculations below the following symbols are employed :

I = No. of I class trees enumerated.

II = No. of trees which were II class at time of enumeration.

III = " " " " III " " " "

(*Note.*—In the formulæ below it is assumed that the actual number of trees, as enumerated, will be reduced before the formula is applied, to allow for trees which will never become exploitable, or will not be removed during the period)

y = average annual yield for the period p.

p = period (*i.e.*, number of years) for which fellings are prescribed.

f = *felling cycle.*

n = number of felling cycles in period.

t = transition period.

^{t}II = time taken for smallest II class tree to reach I class size.

^{t}III = time taken for smallest III class tree to reach II class size; and so on.

(*Note.*—For the sake of simplicity, the calculations refer to the *end* of the growing season in the case of the first three formulæ and to the *middle* of it in the case of the remainder.)

A.—FELLING—CYCLE ANNUAL.

(*i.e.*, whole area gone over each year : an ideal case.)

1. *Period equal to time taken for II to become I.*

(*i.e.*, p = ^{t}II)

$$\text{Then } y = \frac{I + II}{p} \qquad (1)$$

(*i.e.*, all I and all II, when the latter become I class, may be removed during the period.)

2. *Period less than time taken for II to become I.*

$(i.e., p < {}^tII)$

Example :—Suppose ${}^tII$ = 30 years, and p = 20 years.

Then only $\frac{20}{30}$ of II will reach I class size during the period.

$$\text{Hence} \quad y = \frac{I}{20} + \frac{\frac{20}{30}II}{20}$$

$$\text{or} \quad y = \frac{I + \frac{p}{{}^tII}II}{p} \qquad (2)$$

3. *Period greater than time taken for II to become I.*

$(i.e., p > {}^tII)$.

Example :—Suppose p = 30 years.

${}^tII$ = 20 years.

${}^tIII$ = 25 years (*i.e.*, time taken for III to become II).

After 20 years all II will have become I and will have been removed. From the 21st to the 30th year $\frac{1}{25}$ of III will on an average reach I class size annually, making a total of $\frac{10}{25}$ during the 10 years.

$$\text{Hence} \quad y = \frac{I}{30} + \frac{II}{30} + \frac{\frac{30-20}{25} \times III}{30}$$

$$\text{or} \quad y = \frac{I + II + \frac{p - {}^tII}{{}^tIII} \times III}{p} \qquad (3)$$

B.—FELLING—CYCLE NOT ANNUAL.

(*i.e.*, two or more years taken to go round the area: the usual procedure in practice.)

1. *Felling cycle equal to period.*

$(i.e.\ f = p)$

(i) *Felling cycle equal to transition period.*

$(i.e.,\ f = p = {}^tII)$

Example :—Suppose $f = p = {}^tII = 30$.

Then the state of affairs will be :—

At end of year.		*Proportion of II class trees which will have reached I class size, and may be felled.*
1st	...	$\frac{1}{30}$
2nd	...	$\frac{2}{30}$
3rd	...	$\frac{3}{30}$
:	...	:
:	...	:
15th	...	$\frac{15}{30}$
:	...	:
:	...	:
29th	...	$\frac{29}{30}$
30th	...	$\frac{30}{30}$

The number actually removable during the period will therefore be $\frac{15}{30}$II, and the number left on the ground as an unavoidable excess at the end of the period will be $\frac{15}{30}$ II.

$$\text{Hence} \quad y = \frac{I + \frac{1}{2} II}{p} \qquad (4)$$

[This is the simplest case for general use in working-plans but the formula is often wrongly applied to other cases.]

(ii) *Felling cycle greater than transition period.*

(*i.e.*, $f = p > {}^{t}II$).

Example :—Suppose $f = p = 30$ years, ${}^{t}II = 20$ years, ${}^{t}III = 25$ years.

At end of year.		*Proportion of II class trees which will have reached I class size, and may be felled.*		*Proportion of III class trees which will have reached* *II Class size*	*I Class size.*
1st	...	$\frac{1}{20}$		$\frac{1}{25}$	—
2nd	...	$\frac{2}{20}$		$\frac{2}{25}$	—
3rd	...	$\frac{3}{20}$		$\frac{3}{25}$	—
:	...	:		:	:
10th	...	$\frac{10}{20}$	$\frac{1}{2}$ of $\frac{20}{30}$ of all II actually available for felling during the period.	:	:
:	...	:		:	:
15th	...	:		$\frac{15}{25}$	—
:	...	:		:	:
20th	...	$\frac{20}{20}$		$\frac{20}{25}$	—

21st	...	—	$\frac{10}{30}$ of all II available for felling during the period.	$\frac{21}{25}$	$\frac{1}{25}$	$\frac{10}{30}$ of $\frac{1}{2}$ of $\frac{10}{25}$ of III available for felling during *period.*
:	...	:		:	:	
25th	...	—		$\frac{25}{25}$	$\frac{5}{25}$	
:	...	:		:	:	
30th	...	—		—	$\frac{10}{25}$	

$$\text{Hence}\quad y = \frac{I}{30} + \frac{\frac{1}{2}\times\frac{20}{30}\times II}{30} + \frac{\frac{10}{30}\times II}{30} + \frac{\frac{10}{30}\times\frac{1}{2}\times\frac{10}{25}\times III}{30}$$

$$\text{or}\quad y = \frac{I + \left(\frac{1}{2}\,\frac{{}^{t}II}{p} + \frac{p - {}^{t}II}{p}\right)II + \left(\frac{p - {}^{t}II}{p}\times\frac{1}{2}\times\frac{p - {}^{t}II}{{}^{t}III}\right)III}{p}$$

This simplifies to
$$y = \frac{I + \frac{2p - {}^{t}II}{2p}\,II + \frac{(p - {}^{t}II)}{2p\,{}^{t}III}\times III}{p} \qquad (5)$$

(iii) *Felling-cycle less than transition period.*
(*i.e.*, $f = p < {}^{t}II$).

Example :—Suppose $f = p = 16$ years and ${}^{t}II = 20$ years.

Then the following represents the state of affairs :—

At end of year.		*Proportion of II class trees which will have reached I class size and may be felled.*
1st	...	$\frac{1}{20}$
2nd	...	$\frac{2}{20}$
3rd	...	$\frac{3}{20}$
:	...	:
:	...	:
8th	...	$\frac{8}{20}$
:	...	:
:	...	:
15th	...	$\frac{15}{20}$
16th	...	$\frac{16}{20}$

$$\text{Then}\quad y = \frac{I + \frac{1}{2}\times\frac{16}{20}\times II}{16}$$

$$\text{or}\quad y = \frac{I + \frac{1}{2}\times\frac{p}{{}^{t}II}\times II}{p} \qquad (6)$$

2. *Felling-cycle less than, but not a submultiple of, period.*

One case will suffice here, namely, where *the period is equal to the time taken for II to become I.*

(*i.e.*, $f < p$, and $p = {}^{t}II$).

Example :—Suppose $f = 16$ years and $p = {}^{t}II = 20$ years.

Then the following represents the state of affairs :—

	Coupe No.	*End of year.*	*Proportion of II class trees which will have reached I class size and may be felled.*
First felling-cycle.	1	1st	$\frac{1}{20}$
	2	2nd	$\frac{2}{20}$
	3	3rd	$\frac{3}{20}$
	:	:	:
	:	:	:
	8	8th	$\frac{8}{20}$
	:	:	:
	:	:	:
	15	15th	$\frac{15}{20}$
	16	16th	$\frac{16}{20}$

	Coupe No.	*End of year.*	*Proportion of II class trees which will have reached I class size and may be felled.*
Commencement of second felling cycle.	1	17th	$\frac{17}{20} - \frac{1}{20}* = \frac{16}{20}$
	2	18th	$\frac{18}{20} - \frac{2}{20}* = \frac{16}{20}$
	3	19th	$\frac{19}{20} - \frac{3}{20}* = \frac{16}{20}$
	4	20th	$\frac{20}{20} - \frac{4}{20}* = \frac{16}{20}$

*Already removed in first felling-cycle.

$$\text{Then } y = \frac{I + \frac{1}{2} \times \frac{16}{20} \times II + \frac{4}{16} \times \frac{16}{20} \times II.}{20}$$

$$\text{or } y = \frac{I + \frac{1}{2} \times \frac{f}{p} \times II + \frac{p-f}{f} \times \frac{f}{p} \times II}{p}$$

$$\textbf{which simplifies to } y = \frac{I + \left(1 - \frac{f}{2p}\right) II}{p} \qquad (7)$$

3. *Felling-cycle a submultiple of the period.*

One case will suffice here, namely, where *the period is equal to the time taken for II to become I.*

(*i.e.*, $f = \frac{p}{n}$, and $p = {}^{t}II$, where n is an integer and = number of felling-cycles in the period.)

Example 1 :—Suppose f = 12 years, and $p = {}^{t}II = 24$ years ; hence n = 2, and the submultiple is $\frac{1}{2}$.

Then the following represents the state of affairs :—

	Coupe No.		*End of year.*		*Proportion of II class trees which will have reached I class size and may be felled.*
1st felling-cycle.	1	...	1st	...	$\frac{1}{24}$
	2	...	2nd	...	$\frac{2}{24}$
	:	...	:	...	:
	:	...	:	...	:
	6	...	6th	...	$\frac{6}{24}$
	:	...	:	...	:
	:	...	:	...	:
	12	...	12th	...	$\frac{12}{24}$
2nd felling-cycle.	1	...	13th	...	$\frac{13}{24} - \frac{1}{24}^{*} = \frac{12}{24}$
	2	...	14th	...	$\frac{14}{24} - \frac{2}{24}^{*} = \frac{12}{24}$
	:	...	:	...	:
	:	...	:	...	:
	6	...	18th	...	$\frac{18}{24} - \frac{6}{24}^{*} = \frac{12}{24}$
	:	...	:	...	:
	:	...	:	...	:
	12	...	24th	...	$\frac{24}{24} - \frac{12}{24}^{*} = \frac{12}{24}$

*Already removed in first felling-cycle.

$$\text{Hence } y = \frac{I + \frac{1}{2} \times \frac{12}{24} \times II + \frac{12}{24}\, II}{24}$$

$$\text{or } y = \frac{I + \left(\frac{1}{2} + \frac{f}{p} + \frac{f}{p}\right) II.}{p}$$

Example 2 :—Suppose f = 8 years, and $p = {}^{t}II = 24$ years ; hence n = 3, and the submultiple is $\frac{1}{3}$.

Then the following represents the state of affairs :—

	Coupe No.		*End of year.*		*Proportion of II class trees which will have reached I class size and may be felled.*
1st felling-cycle	1	...	1st	...	$\frac{1}{24}$
	2	...	2nd	...	$\frac{2}{24}$
	:	...	:	...	:
	:	...	:	...	:
	4	...	4th	...	$\frac{4}{24}$
	:	...	:	...	:
		...	:	...	:
	8	...	8th	...	$\frac{8}{24}$
2nd felling-cycle.	1	...	9th	...	$\frac{9}{24} - \frac{1}{24}^* = \frac{8}{24}$
	2	...	10th	...	$\frac{10}{24} - \frac{2}{24}^* = \frac{8}{24}$
	:	...	:	...	:
	:	...	:	...	:
	4	...	12th	...	$\frac{12}{24} - \frac{4}{24}^* = \frac{8}{24}$
	:	...	:	...	:
	:	...	:	...	:
	8	...	16th	...	$\frac{16}{24} - \frac{8}{24}^* = \frac{8}{24}$
3rd felling-cycle.	1	...	17th	...	$\frac{17}{24} - \frac{1}{24}^* - \frac{8}{24}^\dagger = \frac{8}{24}$
	2	...	18th	...	$\frac{18}{24} - \frac{2}{24}^* - \frac{8}{24}^\dagger = \frac{8}{24}$
	:	...	:	...	:
	:	...	:	...	:
	4	...	20th	...	$\frac{20}{24} - \frac{4}{24}^* - \frac{8}{24}^\dagger = \frac{8}{24}$
	:	...	:	...	:
	:	...	:	...	:
	8	...	24th	...	$\frac{24}{24} - \frac{8}{24}^* - \frac{8}{24}^\dagger = \frac{8}{24}$

*Already removed in first felling-cycle.
†Already removed in 2nd felling-cycle.

$$\text{Hence } y = \frac{\text{I} + \frac{1}{2} \times \frac{8}{24} \times \text{II} + \frac{8}{24}\,\text{II} + \frac{8}{24}\,\text{II}}{24}$$

$$\text{or } \quad y = \frac{\text{I} + \left(\frac{1}{2} \times \frac{f}{p} \times \frac{2f}{p}\right)\text{II}}{p} \quad \text{where the submultiple is } \tfrac{1}{3}$$

From these examples we may deduce the following general formula :—

$$y = \frac{\mathrm{I} \times \left[\frac{1}{2} \times \frac{f}{p} + (n - 1)\frac{f}{p}\right] \mathrm{II}.}{p}$$

and since $\frac{p}{f} = n$, we obtain the formula

$$y = \frac{\mathrm{I} + \left(1 - \frac{1}{2n}\right)\mathrm{II}}{p} \qquad (8)$$

[*Note* 1.—This formula is only a modification of formula (7), for if the value $\frac{p}{f}$ be substituted for n we obtain

the formula $y = \frac{\mathrm{I} + (1 - \frac{f}{2p})\,\mathrm{II}}{p}$

2.—If we apply formulæ (7) or (8) to the case of annual fellings over the whole area, where $f = 1$ and $n = p$, we find that $y = \frac{\mathrm{I} + (1 - \frac{1}{2p})\,\mathrm{II}}{p}$, whereas according to formula (1) above it should be $y = \frac{\mathrm{I} + \mathrm{II}}{p}$. The discrepancy is explained by the fact that, as noted above, formula (1) applies to the *end* and formulæ (7) and (8) to the *middle* of the growing season, so that the latter show half a season's increment less than the former.]

An important corollary to formula (8) is that where the period, p, is constant, the greater the number of felling cycles in the period, the higher will be the annual yield and the smaller the unavoidable excess on the ground ; for neglecting trees which were I class at the time of enumeration and considering only II class trees which reach I class size during the period, it is evident that the higher the value of n the greater will be the value of the expression $1 - \frac{1}{2n}$ in the formula.

The objection may be raised that some of the above formulæ are of merely theoretical interest. This is true to a certain extent; some of them, however, cover cases which actually occur in

working plans, in which the yield has not been accurately calculated. A common error, as has already been mentioned, is to apply formula (4) to cases to which one of the more complicated formulæ is applicable: this is often done where there are two felling-cycles in the period—a common arrangement in the interests of sylviculture—in which case formula (8) and not formula (4) is applicable, provided the period is equal to the time taken for II to become *I*.

Simplification can generally be effected by making the period for which the yield is calculated equal to the transition period from class II to class I, this transition period being rounded off to suit the requirements of the case, for it is never so accurately determined as not to be alterable to some extent. This arrangement, however, is not always possible, particularly when two or more principal species are under consideration.

So long as the determination of the yield by number of trees bears the importance which it does at present in Indian working-plans for selection-worked forests, its correct calculation is a matter of importance, and as the relations between working-plan period, felling-cycle and transition period from class to class do not appear to be clearly brought out in text-books, it is hoped that the above details may be of some use to working-plans officers, if only as a means of checking their calculations. This limitation of the yield, often to the detriment of sylvicultural requirements, is in the writer's opinion apt to be over-done, based as it frequently is on insufficient *data:* that, however, is another matter, and does not effect the question that accuracy in calculations, if they are to be made, is desirable.

R. S. TROUP.

DEPARTURE ON LEAVE OF MR. J. D. MAITLAND-KIRWAN, ONE OF THE INSTRUCTORS AT THE IMPERIAL FOREST COLLEGE, DEHRA DUN.

On the evening of the 27th ultimo Mr. J. D. Maitland-Kirwan, one of the Instructors of the Imperial Forest College, was invited by the students to a garden party, which was held on the eve of

his departure in order to give them an opportunity of expressing their deep gratitude to him, for his ready condescension in always doing his best to help them, both in and out of class hours, whether at the head-quarter or out in the camp. The President as well as all the other Research Officers, Instructors and Assistant Instructors and Mr. Clutterbuck, Conservator of Forests, were present.

To commemorate the occasion a group photo was first taken of all the officers present with students of the College; several farewell addresses were then read out by the students giving full vent to their feelings of gratitude, admiration and respect for Mr. Kirwan on his departure on furlough, and wishing him a safe journey home, every happiness in the company of his friends and relations there, and speedy return to his duty with renewed health and vigour.

The President of the Research Institute in his brief but eloquent speech echoed the feelings of the students towards Mr. Kirwan and expressed his appreciation of Mr. Kirwan's work, and hoped that it would be possible to again secure his services for a further period for the benefit of the students of the Forest College, on his return from leave.

Mr. Kirwan then thanked the President for his high appreciation of his services and also the students for their address and for their kind wishes. Light refreshment was then partaken of and a band enlivened the proceedings, at the end of which Mr. Kirwan bade good-bye to all.

A STUDENT.

PUNJAB FOREST ADMINISTRATION REPORT FOR 1910-11.

The area of State forests in the Punjab is steadily diminishing and now stands at 8,734 sq. miles. During 1910-11 about 18 sq. miles of reserved and protected forest were given up to the Revenue Department for colonisation. It explained in the report that the areas now to be colonised were never intended for permanent retention as forest, and were only reserved in order to

be eventually abandoned for cultivation. Further surrenders of forest area are under contemplation, but the present extent of the forest lands seems very small in comparison with the area of the province, and it may be hoped that future disforestments will be to some extent counterbalanced by the starting of new irrigated plantations, like Changa Manga, in suitable localities. There is some indication in the report that this is likely to be done.

We read that "the situation as regards working-plans generally is fairly satisfactory," but Form 55 shows that plans have still to be taken in hand for nearly half the total area of reserved and protected forests. No plans are likely to be required for areas which will probably be disforested in the near future, but it is impossible to obtain from the report a clear idea of the still untouched area for which plans are really necessary. A number of the existing plans are said to require revision as it has been found necessary to substitute the group for the selection system in the treatment of Deodar. This may be so but we should like to see proof of this necessity. On the whole it seems that a good deal of urgent work still remains to be done, and it is to be hoped that circumstances will permit of this being pushed on with as little delay as possible.

Under "Communications," the most important undertaking of the year, was the construction of 3 miles of wire ropeway in the Rawalpindi Division at a cost of Rs. 51,207. The system adopted was that which will be familiar to many of our readers from the small show installation in the Forestry Court of the recent Exhibition at Allahabad. In Rawalpindi it is reported to have given "an extraordinary amount of trouble, largely owing to defects in its design," and we are told that the estimated cost was exceeded by twenty per cent, that the plant was not in working order until six months after the expected date, that it will not carry its designed load, and that the working expenses are three times higher than was estimated by the contracting firm. Clearly this new venture has made an inauspicious start. Even the small show installation at Allahabad is understood to have

given a lot of trouble to all who had to do with it, and if the defects are due in any way to Messrs. Ropeways, Ltd., about which we can express no opinion without further evidence, they will have to pay more attention to its requirements if they wish to do much business with the Forest Department in India. Meanwhile the working of the Rawalpindi concern will be watched with interest and future reports from the Punjab will doubtless show to what extent it is paying its way or the reverse. The unfortunate start made by this new departure is the more to be regretted since a considerable number of the ordinary road and building schemes of the year appear to have been postponed or abandoned in its favour.

As in most parts of India, breaches of forest rules continue to rise steadily, the increase during the year under report amounting to 15 per cent as compared with the average of the three previous years. Fire-protection was generally successful in all Divisions except Rawalpindi, where failures amounted to 10·6 per cent. Incendiarism appears to have become a habit in this Division, as we are told that " the desire of the people to obtain fresh grass has little to do with their action in firing the forests." Is it a new and attractive form of recreation, or merely a symptom of general "cussedness"? All we are told is that the Local Government is being asked to take special measures to cope with this fire-raising epidemic, and we take it that punitive closure of the afflicted forests will be part of the plan of campaign. It is said that out of 236 fires, 52 were malicious and 64 were caused by travellers passing through the forests, but Form No. 57 shows that the culprits were actually detected in only 28 fire cases during the year. Surely the origin of most fires in which the offenders escape detection must remain to some extent a matter of conjecture!

Grazing appears to present a difficult problem, and some useful experiments are in progress to test the incidence of grazing permissible in hill forests. If the figures in the forms appended to the report are reliable, the incidence of grazing in the protected forests was one animal for every 1·3 acres, and as the

pastured animals are mostly browsers, it is difficult to resist the conclusion that the existence of many of these forests must be threatened. More than four-fifths of the entire forest area of the Province was open to animals of various kinds and we would commend to the notice of the Punjab authorities the conclusion recently arrived at by the Local Government of another Province :—

" *Very cheap fodder grass as a substitute for very cheap grazing should prove of great advantage to the cattle of the country.*"

Parasitic fungi are giving some cause for anxiety. *Trametes pini* appears to have taken firm hold of the blue pine in parts of at least three Divisions, and we believe that the same pest has recently been shown to attack the Deodar. *Fomes becidies* is destroying the shisham in Changa Manga, and another fungus, as yet unidentified, is found on the mulberry. Fortunately insect pests appear to be of comparatively slight importance. Heavy snowfall is said to have been responsible for much damage last winter, particularly in unthinned coniferous crops.

Attempts at artificial regeneration have almost entirely ceased for the present, as it has been found impossible to carry on such works except at a heavy loss. This should not, however, be regarded as the last word to be said on the subject; it merely indicates the necessity for further experiment and research with a view to the discovery of cheaper and more efficien methods. The most important cultural operations of the year have been thinnings in coniferous forests. The Conservator is of opinion that it is urgently necessary to extend these operations, and it is satisfactory to read that subordinates trained at the Provincial Forest School have shown themselves capable of marking thinnings intelligently. A number of experiments, mostly of purely local interest, are now in progress. It is interesting to find that by dipping the ends of spruce and silver fir sleepers in hot coal-tar, the loss in floating has been reduced to two per cent, the average loss of untreated sleepers being forty per cent. An important series of experiments has been undertaken with a view to ascertaining the best methods of tapping *Pinus longifolia* for resin.

The deductions drawn from these experiments are likely to be *applicable in other Provinces besides the Punjab.*

There has been an increase in the area worked over as well as in the outturn of the forests under practically all heads. An important departure has been the starting of a departmental resin factory near Lahore. The process of steam-distillation employed appears to be worth a trial, though it is possible that superheated steam might give better results on a large scale, and when the Lahore factory has been running for some time, a comparison of its outturn and financial results with those of the United Provinces factory at Bhowali should be of interest and value. We are glad to note that the factory at Lahore has been started with the express purpose of encouraging private enterprise, to which the whole concern will perhaps be made over as soon as it has served to show that the industry can be run at a profit. The departmental share in the business will then be limited to selling to a private company the right to collect crude resin, and Government will cease to figure as a manufacturing agency. We should not be surprised if it is found that there are considerable difficulties in resin collection by a private company.

The actual gross revenue of the year shows an increase of nearly three lacs of rupees as compared with that of the previous year, and amounts to about Rs. 160 per square mile of forest area. This looks small in comparison with over Rs. 500 in the United Provinces, and about Rs. 240 in Bombay, but a considerable portion of the Punjab area is either desert or inaccessible rock and snow, so that the comparison is hardly a fair one. The surplus on the year's working was 48·5 per cent of the gross revenue and amounted to just over seven lakhs of rupees in which is a substantial improvement on the result of the previous year. The Conservator admits that the year 1910-11 was "abnormally profitable" but holds out hopes that the progress will be to some extent maintained, and devotes considerable space in his report to showing that there has been a steady improvement in the finances of the circle instead of deterioration as has been supposed.

The report indicates progress and enterprise in varied fields of forest activity. There are difficulties to be surmounted, but they are apparently being faced in earnest, and in some cases the solution seems to be in sight. Fruit-culture and olive-growing should, we think, hardly have been added to the tasks of a department which has more than enough legitimate work of its own to keep its staff employed at full pressure. The Conservator is of opinion that a "satisfactory report has been presented of results obtained and of foundations laid for future prosperity." We agree with him, but should have held this opinion even more strongly had he left us to form it for ourselves.

PROGRESS REPORT ON FOREST ADMINISTRATION IN THE REWAH STATE FOR THE FINANCIAL YEAR 1910-11.

A change in the *personnel* of the Forest Department of the Rewah State is to be recorded during the year, the post of the Superintendent of Forests having been taken over by Mr. Ganga Prasad Khatri.

The area of reserved forests in the State was increased during the year by 29 square miles, and stood at 1,306 square miles on the 31st March 1911. No settlement of reserved forests is considered necessary, since all forests, as a rule, belong to the State, and are held to be subject to no legal rights of user except under special gifts or *sanads* of the *ilaqadars*.

So far as can be judged from the report, fellings are not carried out under entirely satisfactory conditions. A rough working-plan, drawn up in 1884, and recently revised, applies to the Mukundpur forests (barely 2½ square miles, according to the area statement published), where apparently sylvicultural principles are only partly adhered to: elsewhere correct principles of forest management are set at naught, the surrounding population extracting their *nistar* from the forests at their will. We would commend the attention of the Durbar to this unsatisfactory state of affairs, for even if the main object of management is the supply

of free timber and other produce to the local population, there are correct and incorrect methods of effecting this object, and in the interests of the future maintenance of the forests the better policy is to adopt the former.

Financially speaking, the propagation of lac is by far the most important item in the management of the Rewah forests, the gross revenue derived from this source being Rs. 2,53,762 (of which all but Rs. 273 was obtained from departmental collections) out of a total gross revenue of Rs. 3,39,965. Attempts to introduce improved rules for the working of lac, instituted in the previous year, were not successful owing to the opposition of the subordinate staff; it is hoped that this reason will not be considered sufficient to deter the Superintendent from continuing in his efforts to introduce more scientific methods of working. It would appear that improvements in the methods of manufacturing charcoal are also desirable, the average outturn being only 13 per cent of the reported weight of wood used, which is only about half what it should be.

With regard to sales of lac, there appear to be certain omissions or discrepancies in the Superintendent's report. In para. 56 he states that local sales of stick-lac fetched Rs. 11-12-0 per maund as against an average of Rs. 7-6-0 yielded by contract sales to Messrs. J. Thomas & Co., during previous years; it is not stated, however, if the quality of the lac was identical in each case. Again in para. 58 he mentions that stick-lac converted into shellac fetched Rs. 12-2-0 per maund; this leaves Re. 0-6-0 per maund as the cost of manufacture of shellac. In para. 50, however, it is stated that the cost of manufacture of shellac per maund is Rs. 7-4-10, which does not seem to tally with the previous statement.

Various other important minor products are yielded by the forest of the tate. *Mohwa* flowers and fruits, worth about a couple of lacs of rupees, are given free to the people. Catechu boiling yielded a revenue of Rs. 4,060, corundum Rs. 4,139, bamboos Rs. 19,863, and miscellaneous products such as *harra*, honey, wax, horns, gum, etc., Rs. 28,613.

The gross revenue and expenditure of the year amounted to Rs. 3,39,965 and Rs. 2,19,710 respectively, leaving a surplus of Rs. 1,20,255. This, however, represents but a fraction of the real value of the forests, for the quantity of produce given away free is considerable.

The report, though interesting, is marred by what is in our opinion an uncalled-for vein of criticism of the work of his predecessor by the new Superintendent of Forests. The Rewah State forests have for some time been under the management of an officer of ability and experience, deputed from the Central Provinces; to him belongs the credit of having organised the forests and placed them on as satisfactory a footing as could be expected considering the adverse conditions under which he worked. Such remarks, therefore, as the following, are, to say the least of it, ungenerous :—

"The office work and accounts of the Department were in a deplorable state when the writer took charge of the Department. Much improvement has been made, but a satisfactory stage has not as yet been attained, and it is hoped it will take at least six months to attain it."

For our part we hope that in raising the office work from its former "deplorable state" the Superintendent will also find time to prevail on the Durbar to effect some improvement in the conditions under which the forests are worked.

FORESTRY FOR WOODMEN.*

BY C. O. HANSON.

As the title indicates, this book has been written with the primary object of providing a simple and practical hand-book for the use of foresters and woodmen. There are few persons more competent to produce such a work than the writer, who has had

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* Forestry for Woodmen, C. O. Hanson, Oxford, Clarendon Press, 1911, pp. 222, plates 12, figs. 15.

several years' experience in the instruction of woodmen at the Crown School of Forestry, Royal Forest of Dean. That he has made good use of the advantages possessed by him in this respect is evident on a perusal of the book, which contains a great deal of original matter, based on the author's practical experience, and should prove of great value to the forester and woodman.

Commencing with a brief description of the life-history of a typical tree, including its nutrition, growth, wood structure and reproductive organs, the writer proceeds to deal with the external factors influencing tree growth, and the considerations which determine the choice of species under different conditions. Perhaps the best and most original chapters are those dealing with practical sylvicultural matters, particularly the manner of forming and tending mixed woods of different combinations of species, nursery management, sowing and planting, and the subsequent tending of woodland crops. All these operations are dealt with in a thoroughly practical manner, and contain many useful hints based on the writer's personal experience.

Under the head of Forest Protection is given a brief description of the more destructive animals, birds, insects, weeds and fungi, with measures for combating the damage caused by them; damage by drought, storms and fire are also briefly dealt with. A chapter is devoted to fencing and draining, a number of good practical hints being given; a few diagrams illustrating the text would have added to its value.

Forest mensuration and working-plans are necessarily treated in the simplest and briefest manner possible, the former giving only a few simple rules for the measurement of trees, timber and fuel, and the latter containing a few essential points regarding the formation of working circles and felling series and the general arrangement of headings in a typical working-plan.

The book is written in a clear simple style, and contains some good photographic plates illustrating the sylvicultural subjects dealt with. It will be found of great assistance to the forester and woodman, and we can confidently recommend it to all who are interested in practical forestry in Britain.

THE ELEMENTS OF BRITISH FORESTRY.*

BY JOHN NISBET.

This book may be regarded as an abridgment of the author's larger work "The Forester," and has been written by way of a contribution towards the literature of technical education as outlined in the "Afforestation Policy" of the Development Commission, for the use of Forest apprentices as well as of students of Forestry. The aim of the author is a somewhat ambitious one, namely, to compress into the smallest possible space the four main branches of Forestry, namely, (1) Sylviculture, (2) Management, (3) Protection, and (4) Utilization, and to endeavour to produce a handy volume of small size which will be useful to students and Forest apprentices. As such the book should be a useful one, since the author, with a strict eye to brevity, has dispensed with all superfluous detail and set down in conçise form the main essentials of the subjects he deals with.

The work is divided into four parts. Part I deals with Sylviculture, and comprises an outline of the history of British Forestry, a description of the chief trees and woodland crops of Britain with their sylvicultural characteristics, a consideration of the factors (climate, soil, etc.,) which have an influence on the growth of trees and woods, and a description of the methods employed in forming, tending and regenerating woods, both naturally and artificially. This part is on the whole clear and concise, but if anything it suffers from undue brevity, particularly in dealing with the principal sylvicultural systems. These systems, at all events those which deal with the natural regeneration of woods, are not as clearly understood in Britain as they might be, and it would have been useful to have given a somewhat more detailed account of the main points connected with their application.

Part II comprises Forest Mensuration, Working-plans, and Valuation. These subjects are dealt with in the simplest possible

* *The Elements of British Forestry*, a hand-book for Forest apprentices and students of Forestry, by John Nisbet. Professor of Forestry at the West of Scotland Agricultural College, pp. xii + 345, with 92 illustrations, William Blackwood and Sons, Edinburgh and London, 1911. Price 5*s*. 6*d*. net.

manner, elaborate formulæ being dispensed with. The three height-measuring instruments described are based on the plumb-line principle, and are therefore liable to give inaccurate results in windy weather : it would have been of advantage to describe at least one of the hypsometers or clinometers based on the weighted wheel principle, which are not subject to this defect, and to explain the use of height-measurement tables.

Part III, the Protection of Woodlands, deals with protection against human acts, animals, birds, insects, weeds, epiphytes, fungoid diseases, and inorganic dangers. This part is well written and contains a large amount of useful matter put together in a clear manner. Part IV, the Utilization of woodland produce, deals with the structure, technical properties, and uses of timber, the harvesting and disposal of woodland produce, the transport of timber, its seasoning and preservation, and ends with an account of some of the chief woodland industries, such as estate saw-mills, manufacture of wood-pulp, charcoal-making, resin-tapping, etc. The large subject of Forest Utilization is here necessarily dealt with in the briefest possible manner, only 65 pages being devoted to it ; the writer has, however, got as much material into this small compass as could reasonably be expected.

The value of "The Elements of British Forestry" lies in the purpose for which it is intended. The author *obviously never* meant it as an advanced text-book dealing with all the details of forestry in its various branches, but as a handy book containing the main essentials of the elements of forestry, as applied to British conditions only. As such the book should be of great use to forest apprentices and students.

BAMBOOS FOR BRIDGES.

India is one of the homes of the bamboo, but it is not very much used for bridge building. In Java, however, it is found to serve that purpose excellently. In fact, the Public Works Engineers there have just completed a bamboo bridge more than a hundred feet long with a central span of sixty feet. The road

bed is composed of bamboo matting, covered with a layer of earth. In profile the bridge is said to resemble a steel structure, but all the members are bamboo rods. The Engineers are of opinion that this structure will stand for ten or fifteen years.—(*Capital.*)

DESTRUCTION OF CROPSBY HAIL.

Agricultural India will find the following information, for which we are indebted to the Journal of the Royal Society of Arts, equally interesting and useful :—

The damage to the crops in France from hail is estimated at 150 millions of francs (six millions sterling) every year. Many remedies have been tried, with more or less degree of success, in order to mitigate the evil, not only in that country, but also in Italy and Austria. The principal means adopted for the purpose during the last ten years has been the discharge of explosives during storms in the immediate vicinity of the crops threatened. In many parts of France, and more particularly in the vine-growing departments, associations of the landowners and cultivators have been formed for the mutual protection of their vineyards. In the Beaujolais district last year, no fewer than twenty-three of these societies were in existence; they are provided with 387 cannons or mortars. In another part of the same district, but separated by a considerable extent of unprotected country, there are six other societies with 137 stations for the discharge of rockets. These two groups form the 'Union des Associations Grêlifuges du Beaujolais,' and carry out their operations during storms on a preconcerted plan. In this district there are also several independent associations for *tirs contre la grêle*. The results obtained by these means of defence have, on the whole, been satisfactory in France, where public opinion is more unanimous as to its efficacy than is the case in Italy. The immediate effects of the discharge of explosives, either from cannon, mortar, or by means of a firework (*fusée*), is said to be to abate the thunder and lightning, to stop the wind, and to melt the hailstones before they can reach the ground or injure the plants.—(*The Leader.*)

MATCHES FROM GRASS AND STRAW.

A London paper tells of a process, said to be in the experimental stage, for manufacturing a wood substitute from dried grass or straw, which is primarily intended for use in the manufacture of matches. At the conclusion of the process, which is described as including crushing and stripping the straw and compressing a flat layer between sheets of paper and subsequently moulding the splints, the latter are cut to length and dipped in the match composition. When the scarcity of wood renders desirable the use of a substitute in match making in this country, a fruitful field will be opened to inventors.—(*Scientific American.*)

A TREE FELLING MACHINE.

Consul General Thackara has reported from Berlin another *tree felling machine, in part as follows :—*

"A machine for felling trees has been invented by Hugo Gantke of Berlin. The principle of the invention is that by pulling an ordinary steel wire rapidly back and forward around the tree to be felled, sufficient heat is developed by the friction to burn a smooth groove through the stem of the tree. The machine has been patented in Germany, Great Britain, Austria, and a number of other countries, and a patent has been applied for in the United States.

"The inventor illustrates his invention by means of an ordinary steel wire about a yard in length, which is provided with a single handgrip at each end, which he pulls rapidly back and forth around a chair or table leg, the wire thus burning a groove into the wood.

"A small wire is used on trees, to the end of it being attached cables run by an engine or motor.

"In cutting down trees the cable is chosen long enough to make it possible to place the machine out of reach of the falling tree. The machine may also be used in cutting logs or timber already felled, in which case a shorter cable may be used. The power required for European varieties of wood ranges from 1·5

to 7 horse-power, depending upon the hardness and dimensions of the timber. A 4-horse-power machine is said to cut down a pine 2 feet in diameter in about 5 minutes. The machine requires less than one-half of the time required for sawing down a tree by hand and about two-thirds of the time required for sawing logs or timbers that are lying on the ground. In the case of larger stems the machine requires only about one-fourth the time for sawing by hand.

"The wires are cheap and the whole machine with motor costs $ 650."—(*Forestry Quarterly*).

Mr. Bryant addressed the company in the following well chosen words :—

" GENTLEMEN,—We are assembled here this evening to do honour to our distinguished guest Sir William Schlich. As the senior Forest Officer still on the active list the honour of proposing his health falls to me, an honour of which I am proud.

We are, I think, a gathering which is fairly representative of the Imperial Forest Service of India, we are all members of that service and I am glad to see that no less than 30 of us are present, including representatives of all ranks from the junior officer up to the veteran, who after long and honourable careers are now resting upon their laurels. I had hoped that the probationers now under training at Oxford might also have been present as I am sure they would have wished to be, but unfortunately they have been unable to come as their examinations at Oxford are now being held.

I have received letters from several officers expressing their regret that they have not been able to attend. I will read you Colonel Pearson's letter:

' MY DEAR BRYANT,—Will you kindly tell my brother Foresters, both young and old, how very sorry I am not to be at the dinner they are giving to Sir William Schlich—and to Schlich himself express my most hearty and affectionate congratulations on the splendid services he has rendered to the cause of Forestry both in India and at home in Great Britain.

' With very kind regards to yourself,

Believe me always,
Yours very sincerely,
GEO. F. PEARSON.

Mr. Bagshawe also writes saying how very sorry he is he cannot be present and how fully he appreciates Sir William's many labours in the past and wishes them full success even beyond his hopes in the future Other officers expressing their regret that they have not been able to come to this dinner are—Colonel Bailey, Messrs. Popert, Drysdale, Hart, E. G. Oliver, McCarthy.

We are, I think, all of us acquainted generally with Sir William's career and I will only just touch on the main points thereof and on those which, as officers of the Imperial Forest Service, interest us most.

He was appointed to the Indian Forest Service, as early as 21st December 1866 : he served first in Burma, where he remained three years. He then went to Sind, where he also served for three years; he was Conservator of Forests in Bengal from December 1872 to January 1880, and again he served as Conservator in the Punjab from January 1880 to October 1881. He was then appointed Inspector-General of Forests which post he held until November 1889. He was, however, deputed in 1885 as Professor of Forestry at Coopers Hill and he held this post till the 30th September 1905, a period of over 20 years.

When the forest students were removed to Oxford, Sir William accompanied them and continued to be in charge of them as Professor of Forestry, appointed by the Government until quite lately, when he was appointed Professor of Forestry by the Oxford University. This very brief reference to Sir William's remarkable career is enough to bring home to us the very great value of the services which he has rendered to the cause of Forestry. Apart from the important work which he did whilst in India, the chief result of these services is the high standard of efficiency and ability of the Imperial Forest Service in India to-day.

During the period that he has been in charge of the education of our young Forest Officers 308 men have successfully passed through his hands, *viz.* :—

219 Officers sent out to the Imperial Forest Service of India.
7 Officers trained for Native States of India.
22 Officers trained for the Colonies.

24 Other students.

36 Probationers now under training.

Looking at the Imperial Forest Service of to-day we find it consists of 217 officers, of whom no less than 183 or 84 per cent have been trained by Sir William. I think that anyone who has worked in close touch with our Forest Officers in India will readily be able to bear witness to the high standard of efficiency and character of the men composing the Imperial Forest Service, and to the admirable manner in which the majority of them carry out the work which is given them to do, and which has too often to be done under very adverse and difficult conditions, more so perhaps than is the case in any other service in India. For this high standard of character and efficiency we have to thank Sir William more than any other man now alive, and accordingly in the name of the Imperial Forest Service of India, I beg to tender him our hearty gratitude for the prolonged, invaluable and successful efforts that he has made with the object of improving the personnel and efficiency of that service.

Besides his life-long work connected with India, Sir William has done great work in the encouragement of Forestry throughout the world. Wherever Forest problems are to the fore, we may find his works quoted, and his advice sought. His valuable Manuals on Forestry are, we know, of the greatest value to the Indian forester and are standard works for the increasing number of Governments, States and individuals who happily are interested in Forestry throughout the world. In England there has lately been an important movement for the development of Forestry in Great Britain and Ireland which may lead to great results in the future. Sir William has always taken a great interest in this movement and was perhaps its originator inasmuch as in 1886 he published his pamphlet entitled "Afforestation in Great Britain and Ireland," which drew public attention to the matter. He was a member of the Forest Committee which sat on this subject in 1902 and has published many articles and letters on the matter.

Returning now to India, the period of more than 40 years during which Sir William has been connected with that country

has naturally seen very great changes and developments. When he joined the service the work of the Forest Department was in its infancy, but a great step had already been made in advance by the appointment in 1864 of Sir Dietrich Brandis as first Inspector-General of Forests. This splendid officer at once began to develop and form a Forest administration on lines which, many of them, remain unchanged to this day, and the history of the formation of the Forest administration and of the gradual development of the Forest resources of the Indian Empire, though not unmarked by many a struggle and set-back from the authorities of the day, has on the whole been one of constant improvement and progress.

Any attempt to trace this history in any detail would lead me too far astray, and I will merely remind you that during this period the Government of India have accepted the policy that the maintenance of a due proportion of forests is essential for the well-being of the country, not only for the produce which they yield, but also for the indirect influences which they exert, such as the maintenance of an equable flow of water in springs and rivers.

They have provided, by means of the various Forest Acts, the necessary machinery for the selection, settlement and demarcation of forests, which it is considered should be set aside and managed as permanent forest estates; and in accordance with this machinery a very large area of reserved forests has been formed.

To manage these estates on proper principles, an establishment of all ranks has been organised, and as the area of forests under the control of the Forest Department has increased, many reorganisations have taken place, both of the Imperial and Subordinate services, leading always to an increased personnel, and aiming at increased efficiency. The forest estates as they come under the undisputed control of the State have in great measure been brought under the provisions of working-plans, in the preparation of which great improvement is noticeable of late years.

The Forest School at Dehra Dun, started in 1878, has ever since then done the most valuable work in educating the members

of the subordinate and provincial services. In 1906 a notable step in advance was made by the formation of the Forest Research Institute at Dehra, where a staff of experts is now available for the scientific investigation of all problems connected with Forestry. Arrangements have been made for the better training of the subordinate service and an entirely separate course of training for the Provincial Forest Service will, it is hoped, be shortly brought into force.

We have also seen the lately sanctioned scale of pay for the Imperial as well as the Provincial Forest Service and the creation of two new posts of Chief Conservator of Forests, one in Burma one in the Central Provinces.

The arrangements for educating our young Forest Officers for the *Imperial Service* have undergone several changes. At first the young men were sent to Germany and France, and I venture to think that many good men were obtained in this manner, but in 1885 it was decided that the arrangement under which our young men were sent to the Forest School at Nancy were capable of improvement and it was arranged to send them to the Coopers Hill Engineering College.

Sir William was placed in charge of these arrangements and became Professor of Forestry at Coopers Hill, a post which he continued to hold for more than 20 years.

In 1905 on the abolition of Coopers Hill the forest students were sent to Oxford ; Sir William accompanied them and was appointed by the Government to be Professor of Forestry at the Oxford University ; he held this post until the 1st August, 1911, when the Government appointment which he held came to an end.

As you know the arrangements for training our young men have again been just changed ; what the results of the new arrangements will be is as yet uncertain and there are some features in the scheme which are not accepted as satisfactory by most Forest Officers. The changes made have however for their object the improvement of the education of our young recruits, and must be given a fair trial before any proposals for changing them are likely to be considered.

All these measures to which I have so briefly referred have naturally entailed heavy expenditure on the Government of India, but it has been amply repaid by a more than corresponding increase in revenue which has *always responded in the past to* an increased expenditure.

From this necessarily very incomplete reference to the history of Forestry during the past 40 years we see that there has been constant development and progress. During all this time we have had an Inspector-General of Forests at the head-quarters of Government of India, and it is a fact beyond dispute that much of the progress made has been due to the Inspector-General of the day. He is in the best position to initiate reforms and to place them before the Government of India in the proper way. You will, most of you, have heard that a proposal is now being put forward to abolish the post of Inspector-General of Forests. This proposal which has been simmering for some two years now has grown out of the proposals of the Decentralization Commission, owing to which many of the restrictions hitherto placed on Local Governments are being relaxed and much larger powers being given to them.

Coming after the long list of steps tending to, or at any rate aiming at, the improvement of Forestry in India to which I have just referred, it will I think be held by the majority of those interested, that this proposal, if carried out, will be a most retrograde and unwise step by which the future scientific progress of the Department will be endangered and its status lowered.

At present in India the financial position is no doubt unfavourable, and I believe the proposal is being pressed simply in order to save the few thousand rupees of the Inspector-General's pay. Unwise economy, gentlemen, to say the least of it, and a step which if carried out may result in the loss of many lakhs of rupees from the absence of expert advice at head-quarters, the adoption of unsuitable working-plans or the granting of unsuitable concessions.

If the Government of India desire more revenue from their forests they must spend more, not less, upon them ; establishments

are notably everywhere deficient and officers are very much hampered on this account. There is room for very great future development, but the abolition of the post of Inspector-General of Forests will retard and not encourage this development. Let me read to you what Colonel Pearson, our senior living Forest Officer, thinks of this proposal. He says :—

" I only heard a few days ago of the contemplated abolition of the Inspector-General, it is a most disastrous and retrograde measure for the Department. Decentralisation is all very well for the Civil Service and for the P. W. D. which must be run on practically the same lines all over India, but the forests, as old Bagneris says in his manual, are managed on principles based on observations which differ widely in different parts of the Indian continent. Extreme decentralisation then for the forests must inevitably end in reducing their management to a kind of little Peddlington arrangement which must lead not only to circumscribed ideas but surely also to a loss of revenue which is so dear to the mind of Government ; moreover the abolition of the Inspector-General means a diminution of the 'Izzat' of the Department and I do not see how the needs of the Department can be laid before the supreme Government unless they have some expert adviser."

I have, I fear, wandered from the immediate purpose with which we are concerned, but I hope you will agree with me that any speech in honour of Sir William Schlich would be incomplete without some reference to the past and current history of the service for which he has done so much.

One more point, Sir William possesses in a remarkable manner the power of endearing himself to, and earning the *respect* of, all who come under his teaching ; he is not the dreaded professor, but rather the esteemed friend, who smooths away all difficulties and imparts knowledge, and demands and obtains affection at the same time. I have travelled a great deal in India and have met a great number of Sir William's pupils but I have never heard any but kindly memories of the old professor.

Gentlemen, I ask you to drink to the health of Sir William Schlich."

This toast having been most enthusiastically received, with musical honours, Sir William Schlich at once rose and delivered the following reply, which was most attentively listened to :—

"MY FRIENDS,—I can scarcely express the deep gratification which I feel in coming to meet you this evening, when you have gathered together to do me honour. Here I stand at the age of 71 years with 45 years in the service of the Government of India to my credit, and I thank Providence for having permitted me to be here and to thank you with all my heart for your kind greeting.

Forty-five years is a long time, and great changes have I seen during that period. When I joined the service in 1866 the Indian Forest Department was in the early stage of its development, and I rejoice at the thought that I was permitted to contribute my humble share to its progress.

At that time the Department was beset by many difficulties. Those in authority were still in doubt as to the ultimate usefulness of the measures which enthusiasts, and above all, that grand old forester, Sir Dietrich Brandis, were proposing. But the unrelenting efforts of the Department have now fairly won the battle. It is now recognised that the proper management of the forest is of the greatest importance to the welfare of the people of India, and one-fourth of the area of the country is under the management of the Department, 95,000 square miles have been declared reserved State forests, 9,000 square miles protected forests, and 138,000 square miles are as yet unclassed forests under a certain amount of control, until it has been decided whether they shall remain forests, or whether they are to be made available for cultivation to meet the ever-increasing demand for cultivated land. For, after all, the production of food is paramount.

Again we have enquired into and settled the rights of user in 98,000 square miles, surveyed 74,000 square miles, prepared working-plans for 48,000 square miles, protected against fire 43,000 square miles, and regulated the grazing of cattle. In short, we have initiated an orderly and systematic treatment of

these vast areas, with the result that the net revenue of the forests has risen from Rs. 7,00,000 in 1864 to Rs. 12 million in 1909 These are results of which we may well be proud. And we have done even more than that ; we have induced other parts of the Empire to follow the example which India has set them. Members of our Staff have been asked for and have gone forth to Ceylon, the Straits Settlements, Mauritius, Victoria, New Zealand, South Africa, East Africa, Nigeria, the Soudan, Cyprus, the West Indies and British Honduras. The forests of Siam have been managed by Indian Forest Officers for quite a number of years. Even these Islands have indented on India. The Forest of Dean, the High Meadow Woods, Alice Holt Woods, the Prince's Covert near Esher and the Duchy of Cornwall Woods are managed according to working-plans prepared by Indian Forest Officers, not to speak of quite a number of private forests. The Professors of Forestry at Oxford, Edinburgh and Glasgow, and the Instructor at the Dean Forest School are all former Indian Forest Officers.

Thus we are justified in saying that the development of economic forestry in the British Empire generally has come through India. It is that country which has set the example.

My friend Mr. Beadon Bryant has, in a most generous way, told you that I had a share in this development. For the first 19 years I was active in India, as Divisional Officer, Conservator of Forests and Inspector-General, while I have devoted the remaining 26 years to the education of the recruits for the Imperial Forest Staff. Quite early in my service I came to the conclusion that the most important work to be done was a proper education not only of the superior but also of the subordinate part of the Staff. As early as 1873 I proposed that a School of Forestry should be established in connection with the Roorkee Engineering College. No action was taken on this proposal, but thanks to the action of Sir D. Brandis, the Dehra Dun School came into existence in 1878.

As to the training of the Imperial Staff, it is perhaps not generally known that I urged the Government of India in 1883

(I speak from memory) to oppose the proposal of abandoning the training at Nancy, at any rate for some time to come. However, the Secretary of State in Council decided to start at Coopers Hill, and I was deputed to institute the first British School of Forestry. It was then my duty to do my best, so as to make the new school a success. As you are aware, I remained 20 years at Coopers Hill, when, in 1905, the school was transferred to Oxford. Mr. Beadon Bryant has given you some data as to the number of students trained by me. It may be said that, by the time the Probationers now under training at Oxford have reached India, practically the whole of the Imperial Staff will have been instructed by me. This is no doubt a source of great satisfaction to me, but it includes also a tremendous responsibility on my part. Throughout this long period of time I have tried to place before my students the leading principles of forest management in such a way that they can be applied to any conditions with which they may have to deal. I think I may say that I have honestly tried to do my duty. Mistakes I have no doubt made, but who has not? On the whole I have been assured that the results are satisfactory and I am satisfied that I have been working on the right lines.

And now a new verdict has gone forth, and the few recruits for the Indian Forest Service are to be scattered over the length and breadth of these Islands. Three Universities are to be declared as being fitted to receive our few Probationers, but there is nothing to prevent three or even six others satisfying the requirements of the Secretary of State. I do not think that any one can expect my admiring that arrangement which in the last *Indian Forester* is characterised as a sacrifice of Indian interests to the desires of British Universities. Can any one suppose that half a dozen Universities will establish and maintain an efficient staff for the training of one or two Indian Probationers each a year? As a matter of fact, there is, at present, not room for more than one first class School of Forestry in these Islands, such as we require for the training of our Probationers. I have no doubt that my friend Mr. Caccia, the first Director of Indian

Forest Studies, will work the new scheme for all it is worth, but I cannot help thinking that the several Universities, however eager they are at this moment to comply with the Secretary of State's requirements, will find it rather a burden to maintain an efficient establishment when they find the small number of Probationers which each is likely to get.

There is one other subject on which I should like to offer a few remarks to you before I sit down, and that is the question of the Inspector-Generalship. I have seen various letters in the *Pioneer* showing that the question of abolishing the post seems to be under consideration. Gentlemen, I should consider it a most grievous mistake, if such a step were taken. Provincialise forest administration as much as you like, but for all that numerous cases must come before the Government of India, and to leave it to decide these without a technical adviser is simply disastrous. Nor would the abolition lead to economy, because an additional Assistant Secretary would be required to do the work. The saving would be insignificant if any at all, while the Assistant Secretary would, as a rule, know little or nothing about forestry, and moreover probably be changed every two or three years. Gentlemen, here we have a Department dealing with one-fourth of the area of the Indian Empire, or just about double the area of the United Kingdom, yielding a large net revenue, and yet it is proposed for the sake of a few rupees, to leave the Government of India without a competent adviser. This is penny-wise and pound-foolish! How the Government of India could ever propose such an arrangement passes my understanding.

But now I must not keep you longer. Let me once more say that I am deeply touched by your kindness, which I shall never forget. I shall always be very pleased to see any one of you at Oxford, where I hope to spend the remaining few years, which Providence may grant me.

Gentlemen, I drink to the health of the Indian Forest Service, and success to the efforts of the Department."

A number of other speeches by Messrs. Smythies, Branthwaite, Caccia and Lovegrove, which it is not perhaps necessary to

reproduce, followed. We should like to add that during the course of the evening a desire was generally expressed that an annual Forest Dinner should in future be held in London and it was decided to take steps to give effect to this wish. Mr. Caccia, the Director of Indian Forest Studies, residing at 19, Linton Road, Oxford, has agreed to communicate with all past and present members of the Indian Forest Service in order to put this matter on a proper footing.

NEW FOREST LEGISLATION IN ITALY.

In the last two numbers (July and August) of the *Bulletin of Social and Economic Institutions*, published by the International Institute of Agriculture, there is a special study on the above subject, from which we derive the following details :—

Previous to June 1910 when the law on the State Forest Lands was promulgated, Italian Forestry questions were regulated by the law of 20th June 1877 and some others of less importance. The law of 1877, with a view to ensuring the stability of the soil, a good water system, and, secondarily, good local sanitary conditions, forbade all deforesting and clearing of forest soil, subjecting to the *vincolo forestale* (forestry régime) the woods and lands denuded of trees on the summits and slopes of mountains, down to the higher limit of the chestnut zone, as well as those that by their character and position might, if deforested or cleared, become a public danger.

The law further instituted, in every province, a forestry committee, presided over by the Prefect, to settle the rules for forest cultivation, wood cutting and other delicate matters. But, in spite of these provisions, there was reason to lament an excessive and ill-regulated deforesting, giving rise to landslips, devastating torrents and floods, often producing serious crises in the economy of the mountain regions.

The necessity for special remedial measures was then apparent. Some of these were provided in the law of 2nd June 1910 "*On the State Forest Domain and the Protection and Encour-*

agement of Forestry"; others are contained in two bills (30th November, 1910) the first on *Modifications of the Forestry Law of* 1877 *and Provisions for Mountain Pastures and Agriculture,* the second on "*Forestry Training.*"

The main article of the law of 2nd June 1910 is the formation of a State Forest Administration as an independent institute, "to provide for the extension of forest cultivation and the trade in national forestry produce by increasing the State forest property and rendering it inalienable and by the example of a good industrial régime."

The domain is formed—(*a*) of State forests already declared inalienable; (*b*) of State forests at present administered by the Finance Department; (*c*) of State lands held to be economically only suited for forest cultivation; (*d*) of wooded lands purchased by the Forest Domain Institute or in any way becoming the property of the same; (*e*) of treeless lands purchased or expropriated by the same; (*f*) lands reafforested or to be reafforested, by virtue of special laws, by the Department of Public Works, and that the Agricultural Department shall think fit to incorporate in the Domain.

Woods and lands that thus come to form part of it are inalienable, and must be cultivated and utilised according to a regular economic plan, approved by the Minister of Agriculture, Industry and Commerce.

Art. 17 of the law is especially interesting. It authorises the forestry administration to receive advances and loans from the Land Credit or Agricultural Credit Institutes and the Savings Banks.

For the protection of forest cultivation, it is provided that the woods belonging to the Communes, the Provinces, public institutions, corporations, associations and limited liability societies must be utilised as prescribed by the forestry authority.

For reafforestation of severely damaged woods, the Department is authorised to direct gratuitously the technical labour and to give prizes of from 50 to 100 francs per hectare.

Lands, bare or covered with bush or grass, when they are scientifically reafforested by their owners or by consortiums of

owners are exempted from the land tax for 15 years, if cultivated as copsewood, for 40 years, if cultivated for the production of full grown trees.

The central or local forestry authority further gives gratuitous assistance to the forest cultivators for the defence of small mountain properties and encourages the foundation of associations and consortiums of forest proprietors.

The sum of 33 *million francs* has been assigned for the carrying out of the *law during the first five years;* at the end of which period the amounts necessary each year will be inscribed on the Agricultural Estimates.

To complete this fundamental law, the two bills above mentioned were presented to the Chamber. By *the first*, provision is made for a more scientific system of preserving the woods and grazing lands and for the increase of forest industries. The *vincolo forestale* is modified in accordance with the dictates of science and practical experience, and the provincial forest committee reorganised with the participation of persons technically and legally qualified. The criterium of the chestnut zone, hitherto taken as the limit of the lands of the forestry régime, is consequently abolished. Other provisions deal with the penalties and the conciliation institute for contraventions of the forestry regulations.

Finally, a very important and novel portion of the bill relates to *mountain pastures*. It establishes subsidies for the creation, improvement and regulated use of the grazing grounds and mountain meadows and for the works connected with the regulation of the water-supply. The period damaged grazing grounds must lie fallow is also regulated; this naturally causes a break in the owner's use of them, but he receives adequate compensation during the period the State is arranging for the restoration of severely damaged grazing grounds.

The second bill has reference to "*forestry training*": in it the foundation of a "Higher National Forestry Institute" is proposed, the principal object of which is to provide for the superior technical instruction of the forestry officers required for the service of the special State Forest Domain Institute and for the application of

general and special forestry laws. It is also proposed to institute a "Royal Forestry Experimental Station," to assist in the progress of forest cultivation by means of scientific and technical research. Finally, provision is made for secondary forestry training, itinerant teaching and for the training of the forestry guards.

(Summarised from the *Bulletin of Economic and Social Intelligence*, Year II. N. 7 & 8, July 31st & August 31st, published by the International Institute of Agriculture.)

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A PLEA FOR ECONOMIC FORESTRY.

In Government of India Circular No. 22F, dated 19th October 1894, the general principles of the policy to be followed in the administration of the State forests are laid down and some illustrative examples cited. The foundation of the policy is stated concisely in the following quotation from paragraph 2 of the Resolution :—

"The sole object with which State forests are administered is the public benefit. In some cases the public to be benefited are the whole body of tax-payers; in others, the people of the tract within which the forest is situated."

The remainder of the Resolution shows how the interests of each body are to be weighed, and illustrates in what circumstances one or other should be given preference. For this purpose the forests are classified as :—

(*a*) Forests the preservation of which is essential on climatic or physical grounds.

(*b*) Forests which afford a supply of valuable timber (or firewood) for commercial purposes.

(*c*) Minor forests.

(*d*) Pasture lands.

It is further explained that a forest may occupy an intermediate position or fall under several heads.

The purpose of this article is to consider the position and present management of some of the forests under the second heading, those which properly are administered for the benefit of the whole body of tax-payers, and particularly some of the Himalayan coniferous forests, though the arguments undoubtedly equally apply to many other Indian forests.

The remarkably increased advantage with which Indian forests have been worked, is irrefutably shown by the great increase in the average annual revenue, *viz*:—

1873-4 to 1877-8 ...	... Rs.	67,23,191.
1888-9 to 1892-3 ...	... „	1,51,86,115.
1903-4 to 1907-8 ...	... „	2,50,55,151.

Even further progress in this direction can be expected, but I am convinced it could and should be considerably expedited without any risk being incurred, and, moreover, that it is more than doubtful whether the present policy is calculated to permanently improve the property to the greatest possible extent.

In the case of all forests which can be worked to supply more than a local market, it is a *sine qua non* that the rights and requirements of the local inhabitants are adequately provided for. This is distinctly stated in the working-plans under which most such areas are now worked. So that for the rest, in view of the policy laid down, it is desirable that forests of this class should be worked economically in its narrowest sense; in other words, that the three agents of production (land, labour, and capital) should be employed to produce the greatest profit.

As regards land, little need now be said. It has been laid down that ordinarily permanent agriculture has a prior claim to forestry and the areas set aside for forestry in India have been chosen after due consideration of this and any indirect benefits expected. Due provision for disforestation also has been made should justification for such action arise, so that it may be generally

accepted that the land occupied by forests in India has little present value for other purposes.

The question of labour can more conveniently be considered separately with due regard to other proposals made. It will suffice here to state that the labour employed even under the most intense system of forest management is little compared with that required for the agricultural employment of an equal area and so to disclaim at once on economic grounds the grasping nature not uncommonly attributed to foresters.

It is to the 3rd agent—Capital—I wish to direct attention. By far the greater part of forest capital is in the form of growing woods, it varies in amount according to species, method of treatment and rotation, as well as, naturally, area. To obtain some idea of the magnitude of this capital, and how it varies with the rotation, it is only necessary to consider the case of an ideal forest in which all ages of trees are represented in such proportion as to provide for a sustained annual yield. In such a case if the rotation is 100 years, the value of the immature crops, ascertained by discounting their ultimate value with 3 per cent is over 30 times the annual yield. And if in the same forest the rotation were 150 years and all ages of trees proportionally represented, the value of the growing stock would be three times as great. The capital employed would be trebled. In other words, the yield with a 150 year rotation must be about three times as great as with a 100 year rotation in order *to produce the same financial result*. Obvious and simple as this may seem, the disregard of all such considerations is one in respect of which the present forest policy in India is open to criticism. Gratifying as the increases in revenue and surplus may be, is it not time to inquire in many cases whether the results are commensurate with the capital employed?

In the authorised book on working-plans now current in India, it is definitely stated that "financial tests of the methods of treatment have necessarily been altogether omitted." Now it is not known on what grounds such tests can altogether be disregarded in view of the above and the policy laid down. Nor is this the case in the book in question when treating of the question of the

exploitable age of trees ; the financial aspect is considered, but in a manner which is quite valueless.

After referring to the growing of the greatest volume of the most useful material (*e.g.*, firewood, poles, logs, sawn timber, etc.), it is stated that trees are exploitable when the net price realised per unit of volume standing is highest ; further, that "almost invariably the loss (in conversion) will be least when the trees are largest." From this it seems that in the case of forests grown for timber the exploitable age will almost "invariably" be counted only by the incapacity of the trees to continue growing. Reference is then made to the number of trees of various sizes which can be grown on the same area, and in an example it is assumed that the production of timber per unit of area remains constant, so that again the net price per unit of volume and, from the above, the incapacity of the trees to continue growing alone limits the exploitable age.

Finally it is stated that the correct calculation of the exploitable age is of the greatest importance, but that "Indian Forestry is not ripe for elaborate calculations and must be satisfied when the revenue is highest or the produce most useful." The latter is a primary and obvious consideration and may, for example, place the rotation of firewood-yielding forests within very narrow limits, but in the case of timber-producing forests the age-limits are wide, especially with the present development of Indian industries. In such cases then it is stated that the rotation of the highest revenue must be determined, *i.e.*, the cost of increased revenue is to be disregarded.

Admitting the impossibility of employing *elaborate* calculations, although this is not borne out by some of the working-plans now current, no argument is given for neglecting all financial tests and for employing a method of calculating the exploitable age which, if adhered to, would lead to the ridiculous result in the case of timber forest of growing the trees as long as they would live.

It is known that the rate of growth of trees is not constant and that old trees grow at a very slow rate, this in itself is sufficient reason for not indefinitely preserving old trees unless the improvement in quality makes good the falling off in quantity increment.

Again, the question of the number of stems which can be grown per acre and so the exploitability of crops as against that of individual trees is touched upon, but no means of overcoming the difficulty is suggested by the example given. It is assumed that the mean annual increment remains constant, whether the rotation corresponds to the average age of trees $1\frac{1}{2}'$ or $2'$ in diameter (and which of course it does not indefinitely) and the decision as to maturity is allowed to depend on the net price per unit of volume standing and this in turn on the quality of the timber and percentage of wastage in conversion. That is, in India it must depend chiefly on the percentage of wastage, for the timber market generally does not yet, at all events, discriminate as to quality dependent on changes of rotation within practical limits (say, 75 and 175 years).

No elaborate calculation is involved in applying some elementary financial test when fixing the exploitable age, and it is inconceivable that it is intended that all financial considerations shall continue to be ignored until elaborate calculations can be made.

Little mention is made in existing working-plans of the financial aspect of the rotation, and in timber forests it has been the practice to fix arbitrarily a moderate size of tree which is known to be convenient for conversion, and to determine the exploitable age from that of average trees of the size fixed. Not infrequently, however, the rotation is raised 20 to 25 per cent above the age so calculated, a precautionary measure which betrays want of confidence that protecting and tending crops in the future will produce as good results more quickly than, or even as quickly as, nature unaided in the past, indeed this is sometimes stated.

I have endeavoured to show how both theory and practice at the present time are unsatisfactory, and I now suggest one means of calculating the exploitable age which is not beyond the present state of forestry in many parts of India. In the first place, the proportion of wastage in converting various sizes of trees should be ascertained by actual conversion; this is the basis of what is laid down in the authoritative book, although it is rather suggested that such calculations need not be repeated. In conjunction with

these investigations, observations, where necessary, as to quality improvement can be recorded, and as at present the age of each tree ascertained. Provided with this information for a suitable number of trees, it is easy to apply to the case of the single trees the elementary financial test as to how long increase in quantity and quality of outturn justifies their retention. To do so, the outturn of the older tree must fetch a price, at the very least, equal to that of *the younger, plus compound interest for the period it requires to* attain the greater size.

The only difficulty in making this calculation is to fix a suitable rate of interest, and I suggest two means of overcoming it. Firstly, a rate commonly found suitable to forestry in other parts of the world might be applied, say, 2 to 3 per cent, and since no account can conveniently be taken of the land rental and cost of protection and tending it may be raised a little higher than otherwise thought suitable to the forests. Or, secondly, having ascertained the actual rate at which their value is increasing for different aged trees, the exploitable age can be fixed directly from consideration of these rates.

It may be objected that this is a consideration of the case of individual trees and so inapplicable to the crops that have to be dealt with. To a certain extent this is true. But are we to wait until our crops are normal before we endeavour to treat them on an economic basis? Again the information collected, provided it is obtained from a considerable number of fairly typical trees, may be applied with perfect safety, particularly to crops which are practically virgin and the production of nature unaided. For a forest crop is immature so long as it will increase in value at the minimum rate of interest required and repay the prolonged land rental and cost of management. Now, firstly, I think it should be accepted by foresters that with proper tending the desired crops can be produced more quickly than is done by nature and, secondly, if land rental and cost of management are neglected, the method suggested will postpone maturity and so provide another safeguard against over-felling. The number of trees on a given area, of course, decreases as their age and size increases, but in the method

suggested, from the fact of the lower rotation being taken into consideration, the trees which have to be removed have a market value and that can be raised and re-invested in forestry to give the required return, or, since that is always comparatively low, the revenue can be invested at least equally well in other enterprises.

I have endeavoured to show how no satisfactory means of determining the exploitable age is at present prescribed in India, and how in practice for want of some method it is generally fixed arbitrarily and a very ample margin allowed, lest it be too low, while no account is taken of the future effect of protection and tending. For these reasons and from what has been the experience of foresters in other countries, I am convinced the present rotations, 150 years and more for *deodar*, for example, will be found too high and consequently the capital employed far beyond what is economically justifiable. I now come to the annual possibility; in India it is usually prescribed by area and in the more valuable timber forests further limited by the number of trees to be removed. In the book on Working-plans it is stated that owing to the generally irregular condition of the crops and varying competence of the executive staff, it is not sufficient to limit the fellings by area and cultural rules alone; and that, on the other hand, the prescriptions by volume involve calculations which are not at present possible in India.

The present conditions in India undoubtedly preclude prescriptions by volume as in more regular forests in some countries, but if in a less degree, they also preclude satisfactory prescription by number of trees. The varying competence of the staff stated as the reason for requiring a check beyond area clearly implies something amiss with the training of the staff, and, if that is so, it would not seem to be a difficult matter to rectify. Certainly, experience shows that the numerical safeguard provided is not calculated to add to the competence of the staff, since for the less competent it provides an alternative to the careful application of cultural rules, and it creates doubt in the minds of many of the more competent.

The present practice is to fix the exploitable size and carry out enumeration of trees over the whole or part of the Working Circle. The possibility is then based on the number of mature trees enumerated and the time it will take to replace them, or, on the number of the next lowest diameter class which annually attain maturity and the mature trees already on the ground; in either case allowance is made for a certain number of trees never reaching maturity.

Regarding each tree as it reaches the exploitable size as one which economically should be felled, the 1st class enumerated comprises trees which, theoretically, can, at all events, be felled at once. The 2nd class trees divided by the number of years in the period in which (from ring countings) it is calculated the whole class will become mature is the annual yield for that period. As a rule, however, the whole Working Circle cannot be felled over every year in order to remove the trees which have reached maturity, so that, assuming the growing stock to be evenly distributed, half the number of years in the period it takes to go over the Circle multiplied by the annual yield must be deducted from the 1st class trees in order to ascertain what may be felled at once or in other words the true surplus. The surplus trees can be felled or, carried forward, as considered desirable, and so also can the annual yield be reduced if the state of still lower diameter classes indicates this as desirable.

The method of calculation is of considerable value in ascertaining the approximate yield of a Working Circle and allotting suitable areas for each year's fellings, but some of its modifications are unjustifiable, and when the results are given precedence over sylvicultural rules, as there is an inclination to do, its application is positively harmful.

It would be invidious to cite some specific examples of such modifications and obviously impossible to criticise all. Again the working-plans in question are often the first attempts to substitute order for chaos and their authors may justly claim to be the pioneers of economic forestry. I will only mention the case of one Working Circle where owing to faulty calculation of the

yield and the application of further safeguards it appears that the true surplus growing stock, or inadequately remunerative capital, will be increased by over 150 per cent by the end of the period for which fellings are prescribed.

Again, in the above-quoted book on Working-plans, this method of calculating the possibility is explained, and then it is stated that where the majority of the trees are mature or approaching maturity a modification is necessary, as otherwise "practically the whole forest capital would be removed in a single period." Disastrous as this sounds, what can be the use of retaining capital which is no longer paying interest, or at all events very much too little. How soon unremunerative capital should be replaced by remunerative should depend on sylvicultural considerations alone provided the former can be realised, and if it cannot, then it is better to concentrate the labour available on the more valuable areas until the law of tendency to diminishing return operates.

But, it may be said, the markets will be flooded, there will, in the course of a number of years, be a falling off in the outturn of produce.

To the first argument I reply that the limitations of the markets must be properly gauged, *i.e.*, by calculation of the minimum price which can be accepted and employed to better advantage than by the retention of overmature trees in the forests. These limits do not seem likely to be reached so immediately, when it is considered how timber prices have risen, how inferior timbers are finding a market, how foreign timber can be imported at a profit, and how iron is already frequently being substituted. When, if ever, the limit is reached, fellings can be restricted, but then surely it will be better and more profitable to work smaller areas of the more accessible and valuable forests to their advantage, economically and sylviculturally, than to have modified fellings which are economically unsound, and only too often sylviculturally unsatisfactory, over large areas.

As a matter of fact, it is not so much a fear for the markets as an exaggerated conception of the immediate necessity for absolute regularity in the forests and their yield which is influencing Indian

forestry. And, if this were the ultimate aim of Indian forestry, I doubt whether the present method is even the quickest to attain it. With markets in their present condition and forest crops very irregular, I have no doubt slight irregularities of supply, which it might be impossible for Conservators to avoid if the possibility were fixed by area alone, would not dislocate the markets, while, on the other hand, increased supplies would lead to their exteusion.

So far as the possibility of a falling off in the outturn of produce is concerned, the optimistic view should at least carry as much weight as the pessimistic, when considering the probable results of professional tending and protection ; and there seems no reason to hoard up India's timber wealth in order to stave off a time when she will have to content herself with the most her forests can be made to yield permanently.

As regards the sylvicultural aspect of the question : to induce regeneration of the desired species *under any shelter wood system* (the cheapest if successful) the fellings must be made with due regard to the sylvicultural requirements of the species and the varying quality of the locality ; their intensity cannot be laid down mathematically for a single coupe, far less uniformly for all coupes in Working Circle. Disregard of this must lead to favouring the regeneration of more shade-bearing species where the fellings are too light and *vice versâ.*

To recapitulate, it is obvious that virgin forests are likely to contain a preponderance of trees mature or approaching maturity (in many cases never likely to attain it) and that consequently such forests are bearing the burden of excessive capital ; with such forests abundant and no attempt to calculate the proper extent of capital *on an economic basis,* there is a natural tendency to caution in modifying nature's methods and consequent over-capitalisation. There is no justification for rigid Working Plan prescriptions which place, or have the effect of placing, regularity of yield before all else, this is particularly striking when it is considered for what vast quantities of serviceable timber a market has yet to be created ; and finally it betrays a want of confidence in the sylvicultural principles which have been established.

To summarise the present position, the progress of forestry in India has been so great that the attempt to apply systematic forestry to vast areas beyond what the staff available can control, has only too often resulted in an apology for sylviculture and neglect of primary business principles. Not economic forestry but consumption, regulated but generally timid, has resulted with production almost entirely left to nature. Some relief has been sought in the sale of trees standing in place of exploitation by departmental agency, but such relief is neither satisfactory nor adequate so long as the purchasers are unaccustomed to the work or not quite reliable, and by the time they are, it is certain the deficiency of professional labour will be even greater than now.

Profit and loss are measures of economic employment of the agents of production; assuming that in Indian forestry the land may be left out of consideration as having little or no value for any other purpose, is it right that the annual surplus should be taken as the measure of successful administration except of the undertaking in its absolute infancy? It takes account of the labour employed, but entirely neglects the capital. Yet the surplus remains the layman's standard of judging the progress of the Forest Department much to the annoyance of many a forest officer who has endeavoured to make the capital employed in his forests permanently more remunerative, instead of being content with more extensive lumbering. It seems to me that this misconception needs to be removed and regular and permanent progress and a claim to a considerable strengthening of the staff sought in demonstration of sylviculture on an economic basis.

A. D. BLASCHECK.

STRENGTH OF PLANTATION AND NATURAL-GROWN TEAK IN SOUTH INDIA.

The following extract from a letter from the Forest Economist to the Conservator of Forests, Southern Circle, Madras, has been forwarded to us :—

COMPRESSION TESTS.

Log No.	Specimen No.	Size of piece tested.	TOTAL WEIGHT APPLIED IN TONS.		PER SQUARE INCH IN TONS.		MOISTURE AT TIME OF TESTING.	
			Plantation.	Natural.	Plantation.	Natural.	Plantation.	Natural.
1	a	2" × 2" × 4"	15·24	12·70	3·79	3·19	Not recorded.	...
	b		13·81	13·54	3·45	3·39		
2	a		14·12	14·22	3·53	3·56	16·29 % on 10th April 1911.	...
	b		15·47	13·72	3·87	3·43		
3	a		14·57	12·64	3·64	3·16	Not recorded	...
	b		14·36	12·75	3·59	3·19		
4	a		14·90	13·93	3·72	3·48	Not recorded.	20·01 % on 10th April 1911.
	b		14·33	13·30	3·58	3·32		
Average...	...	...	...	...	3·65	3·34	...	...

SHEARING TESTS (SHEARING TOOK PLACE AT TWO DIFFERENT POINTS IN EACH PIECE).

Log No.	Specimen No.	Size of piece tested.	TOTAL WEIGHT APPLIED IN TONS.		PER SQUARE INCH IN TONS.		MOISTURE AT TIME OF TESTING.	
			Plantation.	Natural.	Plantation.	Natural.	Plantation.	Natural.
1	a	1″ × 2″ × 4″.	3·22	3·48	·805	·870	...	...
	b		3·57	2·80	·892	·700		
2	a		3·24	3·58	·810	·895	6·29% on 10th April 1911.	...
	b		4·50	4·00	1·120	1·00		
3	a		3·84	3·75	·960	·938	...	...
	b		3·62	3·64	·905	·910		
4	a		3·93	3·32	·982	·830	...	20·01 % on 10th April 1911.
	b		2·85	3·04	·760	·760		
Average...	...	...	...	...	·904	·863	...	...

TESTS FOR TRANSVERSE STRENGTH.

Log No.	Specimen No.	Size of piece tested.	TOTAL WEIGHT APPLIED IN TONS.		PER SQUARE INCH IN TONS.		MOISTURE AT TIME OF TESTING.	
			Plantation.	Natural.	Plantation	Natural.	Plantation.	Natural.
1	a	2″ square and 20′ long.	1·56	1·54	5·85	5·77	...	...
	b		1·44	1·60	6·40	6·00		
2	a		2·02	1·63	7·57	6·[illegible]	...	...
	b		1·60	1·47	6·00	5·51		
3	a		1·79	1·68	6·71	6·30	...	...
	b		2·00	1·75	7·50	6·57		
4	a		1·47	1·62	5·51	6·07	...	...
	b		1·97	1·60	7·39	6·00		
Average ..	...	...	...	...	6·62	6·04	...	...

"The figures of all three tests show the *plantation* slightly stronger than the *natural* teak. I put this difference down to the 4 per cent. excess moisture in the latter samples. It is a point of considerable interest. I would ask you to allow me to draw your attention to my remarks on this subject on page 3 of my Forest Bulletin No. 3 of 1911 on the subject of Plantation and Natural Teak in Burma. Again, though no true comparisons can be drawn between Burma and Nilambur plantation teak, as the localities are different, it is interesting to note that Burma plantation teak with 10·83 per cent. of moisture as against 16·29 per cent. in the Nilambur product, gave slightly higher results for test of transverse strength. In the compression tests the effect of moisture is not so important a factor, while in shearing tests it may possibly be that moisture increases the power of resistance."

OUDH AFTER BURMA.

It is five o'clock and I wake suddenly as a lamp is brought into the verandah to light my friend to his *chota hazri* displayed on a chair at his side. Outside the chaprassis are already practising their exercises for the throat which seem to do their voices so much good, and enable them to hear each other distinctly when conversing at the top of their voices at a distance of three yards. S. likes his tea before he washes his face, and I like to wash my face before I have my tea, so I get up to do so. We are off to-day to see an outlying part of the forest and start on the elephant at half past five. Elephants are gentlemen (or ladies) in Oudh and do not have to carry vulgar loads of miscellaneous camp kit. We sit on a platform made of a sort of bedstead upside down lashed to the pad, but as soon as we have left the dusty roads near the rest-house I get off and walk as the motion is trying when long continued. Not so trying as a howdah, however. During my first two days on a howdah I stood a good part of the time so as to adapt myself to the motion as much as possible. Of course the further one is above the elephant's back the more the motion is exaggerated, so one sees most people travel on the pad elephant

and go into a howdah only for shooting. The country is flat and not a hill is seen nearer than the mountains of Nepal far in the north, rising up to the distant snow-covered tops of the highest. The jungle is very open, and from the top of the elephant the view is extensive and field glasses most useful. A mile out we see a solitary pig running across, dodging behind the crooked scattered cutch trees and through the tufts of coarse grass. He reaches a flat open grassy hollow and canters steadily away through this, disappearing half a mile off in a green thicket of *Trewia* and *Eugenia*, which runs at an angle with our line. We pass the end of it directly and see a dozen spotted deer standing on its edge. They have seen the elephant afar off but stand while we examine them with the glasses. Rather like fallow deer they are and this lot has no stag with them. In May one has to be careful as some of them are in velvet, though most have mature horns. For a couple of miles after this we jog along through open grassy land with middle-sized *Bombax* trees standing here and there among the more plentiful scrubby cutch. Then far on the left my companion spots a nilgai or blue-bull. He is standing close to a tree and staring at us. We alter our course a little and make a line to pass one side of him, and in this way get up to about a hundred yards distance. Then he bounds off but S. has stopped the elephant and got a shot before he has gone many yards and drops him. The elephant, which took no notice of the shot, is pushed ahead but he is up again and off—to fall again to a closer shot and wait to die decently at the hands of the Mahomedan mahout who administers the *halal* and makes the meat eatable for all the Mahommedans in camp. Some Hindu wiseacre long ago christened the animal a blue cow so that no Hindu will touch the meat, though he is an antelope and not at all a cow. On another day we got a big bull nilgai which died before the mahout could reach him, so that hardly a man in camp would touch him. He is a curious shaped animal, blue gray in colour and very high in the withers so that he looks strangely foreign cantering away through the grass. His horns are short and form little of a trophy, but nilgai are shot fairly often to keep their numbers down, as they

are most destructive to the outlying unfenced crops. In the hot weather they seem to keep mostly with their own sex as we saw bulls in twos and threes and once nine together. The cows are smaller and grayish in colour, and a big bull with shoulders and crest like a Clydesdale stallion stands well above them. His knees are bare like a goat's, though it is not likely that he kneels to graze as a goat does. His skin makes excellent leather for camp cots. A message is sent to a village for a cart to bear the meat to camp and we go on and enter a stretch of small tree jungle. Soon we stop suddenly and the mahout who has been looking ahead points out a spotted deer standing motionless with braced legs watching us. It is my shot and it is not difficult to drop him on the spot with a shot behind the shoulder, a medium-sized head and my first. Having been duly *halaled* he is hoisted on to the elephant with his bound legs over the short wooden pillars which stick up at each corner of the pad, and there he hangs over the elephant's tail. We swing round in a semi-circle to see some other forest and on the way home have a good look at some forty or fifty spotted deer walking slowly along under the trees. The spots show up well on the light coloured hides of the does and the darker coats of the stags. They are all alarmed and stand still to stare, but the stags, of which we count nine, seem small and they are left in peace. A day or two later near the same place I saw a herd of about twenty-five containing a very good stag. By getting off the elephant and doing a long stalk, I got quite close to them and watched the herd move slowly away but there was no sign of the big fellow. On my right was a patch of very high grass and suddenly as I stood he burst away through it and gave me a chance which I missed. He had been standing motionless less than 10 yards from me.

It is hot in Oudh in May so when we get back we find the rest-house shut up, with chicks on all the doors and windows. The building is of masonry, two rooms downstairs and two upstairs with verandahs, and the walls are 2 feet thick. They treat themselves to a good deal more furniture than we do in Burma, and we can spend the day until four o'clock comfortably inside and hardly

need a punkah. Coming in from the forest one sometimes sees the bungalow a couple of miles off on the plain, showing up large and white above the small scattered trees with a few better sized *Bombax* near by, which provide a little shade for tents. It is remarkable how this tree comes up from seed on these plains wherever a small thicket of thorny *Zizyphus* protects it from the enormous herds of white cattle which graze here. These are furnished with a very useful looking pair of sharp horns, and though the ordinary cow is quiet and harmless enough, when the herd is angry, as the babu said, they will not do so. On one occasion several of us on elephants passed a large herd which had been excited by the cattle-men shouting to them in a peculiar way. They are said to do this when a leopard or other danger is near, and the cattle were circling round the men in large droves. They looked rather formidable, but from our elevated position we were able to look down on them with scorn not mingled with derision! Smaller herds of buffaloes showing most of their bones are also common and among them a number of the bulls have light coloured hair on the forehead and China blue eyes. They compare very badly with the Burmese buffaloes, and wear instead of wooden bells very long brass or copper bells which ring through the forest with a sound like the bell of a Free Kirk in the Highlands. They graze all over the enormous *phantas* (open spaces) which occur in the *sal* and open forests. In some parts the *sal* occupies the high land right up to the edge of a sort of plateau, where there is a drop of 20 to 30 feet down a fairly steep bank and the open forest begins. The *sal* forest is mostly dense and divided up by straight lines which vary in breadth up to 100 feet, and often radiate from a bungalow whence the divisional officer sallies out in his trap along the lines when the road happens to be good enough. The *sal* looks rather like *ingyin* and there seem to be few trees above 6 feet in girth. Not far from one of the rest-houses was a very large *phanta* or *lwin* where a small village had a patch of wheat fields. On a couple of evenings we went out here to look for black buck and though we saw a good many we did not bag anything. They seem to live in small herds of two or three, or a dozen or

twenty together, but on one occasion I saw a solitary buck. The bucks are easily distinguished by their long horns and black backs, the does being much lighter in colour. They keep entirely in the open and when fired at the herd makes off, each animal leaping high in the air. I got one finally by walking more or less in his direction and taking a shot at about 100 yards, but he moved as I fired. As he bounded away a second lucky shot brought him down. It is pretty shooting and not so often successful as to get stale. He fell just outside the reserve boundary, which is marked by white masonry pillars running in a line across the grass land with a ditch joining them. His horns were fair for the U. P. where they do not seem to run so long as in the Central Provinces. Through the flat land runs a muddy winding stream and here, as in others like it, are found both the long-nosed Ghariyal (fish eating crocodile) and the Mugger. The former is common and 6 feet specimens may be seen in patches of half a dozen on the mud banks during the heat of the day. My friend had a long shot with a telescopic sight at a twelve-footer and hit him in the only vital spot, rather far back in the neck. If hit anywhere else they usually struggle back into the water. The snout is long and narrow and furnished with rows of most useful looking teeth. They are very wary and, however log-like they may appear, usually gently subside into the water at the first sight of danger in the distance. Their skins make excellent leather. On the far side of the small stream is a patch of pure white on the open; as we get near it turns out to be a flock of white cranes with some spoon-bill storks and ordinary black and white storks. These and the black red-headed ibis are very handsome birds, and may be seen in small numbers in many places near water, with the big blue red-headed crane and the pelican. But the peacocks are the bird of Oudh above all others at this time of year. Hundreds may be seen from any camp and every fourth bird has a magnificent tail. One only I saw disporting himself with his tail up, probably we were rather late in the season for this performance, as egg-laying had begun and nests were to be found. The common plover is as noisy and irritating as he is in Burma, and I watched one chasing a brown

monkey away from the grass, where his nest was probably hidden, with vicious dives and pecks. These ordinary monkeys are common, usually on the edge of the tree forest wandering along the ground in flocks. The langur, the grey monkey with bushy white whiskers is also common and is a much handsomer beast. The crows led us one day to the remains of an old one which had probably been killed by a panther and we found the clean picked skull, very human except for the large canine teeth. We did not shoot any birds as the nesting season was on, but saw the large handsome swamp partridge, something like an English partridge but much larger, the black partridge or francolin resembling the Burmese *Ka* but blacker, and the small grey partridge. The black partridge calls much as the Burmese bird does, but his voice is weaker and not so harsh. A few quails and snipe were seen and the goggle-eyed plover which I had seen once or twice in Upper Burma and watched for some time, at a loss to name it. On one beat we put up a florican (bustard). Vultures abound and find plenty to eat with such large herds of cattle on the ground. These die off in hundreds in an unfavourable season, as during the rains of last cold weather, and the forest revenue is increased by the sales of the right to collect bones and horns. One morning we got near to a large herd of spotted deer, which were accompanied by half a dozen blue-bulls. One of each was shot and we waited a while to see what the deer would do as they were quite in the open and apparently did not know what to make of the shots. Within a minute a dozen vultures were down at each, and we had to stand by both corpses and keep them off until the men came up.

By wandering round the jungle in this manner, mostly on an elephant, one may see at times an extraordinary number of animals, but the people living in the province who shoot do most of their shooting by beating. I was fortunate in being asked to attend several beats with a party of half a dozen who had brought up a dozen elephants, and although we were not very successful, most of the beats brought out animals of sorts. I saw spotted deer, swamp deer, peacocks, a mongoose, pig, hyenas and panthers come out, but none of the stags were worth shooting. The first hyena which

I saw through the jungle made me sit up as the yellow striped skin at the first glimpse glanced through the trees like a tiger. In his beat another lucky hyena would probably have been killed by a sportsman who had unfortunately forgotten to put a cartridge in his rifle. On asking the Hindustani name of the animal on this occasion I was told that it was *lakarbagha.* They are said to come and interfere with kills now and again. Near one of the rivers were some large stretches of low tamarisk scrub in which we had some beats for swamp deer sitting on native bedsteads tied upon slender poles but although a fair number came out, they were all does or very poor stags, as apparently the good stags nearly all drop their horns by March. The whole herd swam across the river after one of these beats to escape. Sambur seem to be rare in the flat country and barking deer not nearly so common as in Burma. Hog deer we saw occasionally but none with heads. The beating was usually done by 30 to 40 men with half a dozen elephants and they made a fair amount of noise. Two panthers which were shot in a beat must have been lying not far from the *machans* beyond the first beat, as they came out in the second beat which was towards the same *machans* from the opposite direction and were both killed by one gun. They had been located in the neighbourhood as they killed a goat tied up not far off. Snakes seem to be extremely rare or they keep in cover during the heat, but I saw a couple of big lizards. They make when disturbed for hollow trees, in one of which some one had cut a window 6 feet up which he duly looked out of to see if I was still there when I had chased him up it. They seem to be remarkably sound sleepers. In Burma I remember finding a large one at the bottom of a pool and I had to give him several severe prods with a stick before he would bolt, and in Oudh we found one asleep in the sun on the grass where he stayed until the elephant nearly trod on his tail. Oudh remains to me a place of great spaces and distant views, in the open forests and down the long *sal* forest rides. Round the few villages wheat fields are being reaped and a fire-watcher's hut is met with now and again. In the hot weather the felling has stopped and few people are about, and in the rains everyone leaves the forests and

rests in healthier spots. I suppose there is nothing more peaceful than a railway station far in the coufitry at home on Sunday, and it came back to me as I spent part of a day waiting for a train at the end of a railway line near the Nepal border, where the line simply stopped half a mile from the bank of a river near a wheat field without building or telegraph line. The one train of the day arrived about eleven and slept there till two, when it went back, taking away a few almost empty carriages and some trucks full of wheat. I put a table and a chair under the one tree which provided a little shade and basked there, in the silence and the heat, like a vegetable-marrow, until the train left.

In Oudh (of course all this time I am speaking only of what I have seen), you can hire as many carts as you like at eight annas a day, you can buy a sheep for one rupee and a half grown buffalo to tempt a tiger for five. You can get as many men as you want at seven rupees a month, you can go out and see more game in a week than you would in Burma in a year, with a tenth of the trouble, and you can take your ease in a pukka bungalow furnished with every luxury—but Burma has its points too.

A. R.

RE-DISTRIBUTION OF FOREST DIVISIONS IN THE MADRAS PRESIDENCY.

The following is the re-distribution of forest districts in Madras due to the formation of a fourth Circle :—

NORTHERN CIRCLE.

Head-quarters, Waltair.

		Forest area sq. miles.	Classed as
Ganjam	...	598	Major
Vizagapatam	...	302	Minor
Lower Godaveri	...	482	Major
Upper ,,	...	428	Minor
Kistna	...	297	Minor
East Kurnool			Major
West ,,	...	2,640	Major
South ,,			Major
Total	...	4,747	

CENTRAL CIRCLE.

Head-quarters, Madras.

		Forest area sq. miles.	Classed as
Guntur	...	814	Major
Nellore	...	737	Major
East Cuddapah	...	1,083	Major
North ,,	...	736	Minor
Bellary	...	690	Major
Anantapur	...	782	Minor
Chittoor	...	840	Major
Chingleput	...	213	Minor
Total	...	5,895	

SOUTHERN CIRCLE.

Head-quarters, Trichinopoly.

		Forest area sq. miles.	Classed as
Vellore, North	...	500	Minor
Do. South	...	751	Major
South Arcot	..	346	Minor
North Salem	...	839	Major
South ,,	...	587	Major
Trichinopoly *cum* Tanjore		360	Major
Madura	...	666	Major
Ramnad	...	439	Minor
Tinnevelly			Major
Total	...	4,488	

WESTERN CIRCLE.

Head-quarters, Coimbatore.

		Forest area sq. miles.	Classed as
Kollegal	...	705	Minor
North Coimbatore	...	919	Major
Central ,,	...	351	Minor
South ,,	...	457	Major
South Malabar	...	227	Major
North ,,	...	262	Major
Nilgiris	...	568	Major
South Canara	...	986	Major
Total	...	4,475	

"NATURAL-BORN BRITISH SUBJECTS."

At a meeting of the Viceroy's Legislative Council the following question was asked by the Hon'ble Mr. Sachchidananda Sinha :—

(*a*) Is it a fact that in the rules lately published in regard to appointments in the Indian Forest Service, it is laid down that candidates applying for appointment as probationers must be "natural-born British subjects?"

(*b*) Is the above expression precisely the same as "the natural-born subjects of His Majesty?"

(*c*) If not, will the Government be pleased to state whether the expression "natural-born British subjects" includes or excludes the Indian subjects of the King-Emperor?

(*d*) If the latter, do the Government intend to so amend the rules as to make Indians also eligible for all appointments in this department, equally with other subjects of the Crown?

The Hon. Mr. Carlyle's reply was as follows:—

"The reply to clauses (*a*) and (*b*) is in the affirmative, and the expression 'natural-born British subjects' includes Indian subjects of the King-Emperor."

THE FORESTS OF THE PHILIPPINES.

BY H. N. WHITFORD, Ph.D., 1911.

This publication forms Bulletin No. 10 of the Bureau of Forestry, Manila, whence it can be obtained for about 4 rupees. It consists of two parts, *viz.*, I.—*Forest Types and Products*, and II.—*Principal Forest Trees*, and, as is the rule with American forest literature, it forms an attractive publication measuring 9" × 6", well printed on good paper and with numerous excellent illustrations. It is of special interest for Indian forest officers seeing that the types of vegetation described closely resemble those of an Indian forest and contain a number of identical species. The chief object of the bulletin is to draw attention to the field available for the successful investment of capital in exploiting the forest resources of the Islands,—"it is estimated that the forests properly managed can be made to yield 2 billion board feet annually, without being damaged. This will allow a rotation of 100 years. While there is no prospect of the full utilisation of the forest wealth in the immediate future, with sufficient investment of capital, there is little reason to doubt that within the next ten or fifteen years the annual output of timber in the Philippines will reach the 500 million mark."

The total area of the Islands is given as 120,000 square miles which consist of:—

Virgin forests	... ...	33 per cent.
Second-growth forests	... ...	17 ,,
Grass-lands	... ...	40 ,,
Cultivated land	... ...	10 ,,

The extensive grass-lands are said to be occupied chiefly by *Imperata exaltata* and *Saccharum spontaneum*, but the possibility of utilising these species for the manufacture of paper-pulp appears not to have been noted. These grass-lands are said to have arisen from a system of shifting cultivation and the repeated firing of such areas prevents the re-establishment of woody species. It is pointed out that successful cultivation of these grass-lands is very expensive and that many Filipino farmers first plant seeds of some small rapid-growing trees, allow them to grow and shade out the grasses, then cut and burn the wood, and plant their crops.

In the natural reforestation of the grass-lands *Pinus insularis* is the chief tree in the high regions and in the lowlands the following familiar species first come in: *Antidesma ghæsembilla*, *Bauhinia malabarica*, *Eugenia Jambolana* and *Albizzia procera*. It is noted that "the prevention of further destruction of the virgin forest, and the reforestation of the grassy regions on non-agricultural lands, both by the prevention of fires and by planting, are the greatest forestry problems of the Philippine Islands."

The climate of the Islands varies considerably. June—October is the rainy season, but the annual rainfall varies from 36″ to 160″ in different localities. In some localities there is, and in others there is not, a pronounced dry season. In the former the forests are more or less deciduous, in the latter they are usually evergreen.

The outstanding feature of the forests is the pre-eminence of trees belonging to the family *Dipterocarpaceæ*. It is estimated that forests of the dipterocarp type occupy 75 per cent of the total area of the virgin forests and that 70 per cent of the total standing timber in the Islands is produced by trees of this family. The chief trees belong to *Shorea*, *Dipterocarpus*, *Pentacme*, *Parashorea*

and *Vatica;* practically all of them are large trees, the largest attaining a height of 200 feet and diameter of 7 feet. The yield varies from 20 to 450 cubic meters of merchantable timber per hectare, and as these species usually occur in pure woods, they are adapted for lumbering on a large scale. It is pointed out that "the quality of the dipterocarps, which permits them to bear shade, is thought to be the main cause of their success in occupying large areas in the better soils," also that the dipterocarps "have soil moisture requirements that will not permit them to exist in the drier soils of the limestone regions."

Where the water-level is near the surface in forests of this main type, *Pterocarpus indicus, Terminalias, Celtis, Erythrina indica, Macaranga, Mallotus, Albizzia, Hopea, Dillenia* and others appear.

The only dipterocarp which is noted as being wholly deciduous (and this only for a day or two) is *Anisoptera thurifera* which is found in localities with a pronounced dry season. At an elevation of 400 to 900 meters *Shorea polysperma* occurs in association with oaks and forms a sub-type of forest.

Above 900 meters the "mossy-forest" type is found, which contains *Dacrydium, Podocarpus, Eugenia, Quercus, Myrica, Engelhardtia, Acronychia, Symplocis,* and others. The trees here are dwarfed and do not, as a rule, exceed 5 meters. Few mountains in the Philippines attain a height of more than 2,000 meters.

Other forest types are the *Molave (Vitex parviflora)* which extends up to 150 meters, the Pine (*P. insularis* and *P. Merkusii*) which is usually found above 900 meters, the Mangrove between low and high tide, and the Beach (containing *Terminalia catappa, Erythrina indica, Pongamia glabra, Thespesia populnea* and others) near sea-level.

It is noticeable that neither the Sal nor the Teak is indigenous in the Islands, although the latter has been planted to some extent.

The principal uses of the various timbers are detailed, with notes on weight, hardness and the results of mechanical tests. Information is also supplied regarding minor products markets, existing methods of logging, milling, transport, labour and charges

The felling regulations consist in fixing a minimum diameter limit' while "where there is danger of the extinction of valuable species, the Government reserves the right to select the trees to be cut." A map of the Islands indicating the approximate distribution of the chief forest types concludes Part I.

It is estimated that the forests contain 2,500 tree species but many of these, even of the dipterocarps, have not yet been botanically determined or defined, while considerable areas still remain to be explored. In Part II, however, popular descriptions are given of 106 of the principal trees which are at present exploited. The descriptions are amplified with excellent illustrations, indicating the general characters of leaf, bark, infloresence and fruit of most of the species, and aim at facilitating identification by means of easily recognised field characters. The inclusion of a scale would, we think, have considerably increased the value of these plates. Sylvicultural notes, chiefly dealing with soil and light requirements, are added, together with details of economic uses, distribution and local vernacular names. Vernacular names are used freely throughout the paper and a complete alphabetical index of these giving the scientific equivalents with references to both parts would have been useful.

Copies of the bulletin can be obtained from the Bureau of Forestry, Manila, P. I., for \$1·25 gold (about 4 rupees) post paid. Seeing that the bulletin contains no less than 131 full-page plates, the price is clearly very moderate.

In many respects the present publication admirably fulfils the function of a local Forest Flora designed for the use of the practical "forester or lumberman," who is not necessarily a botanist, and the system of profuse and cheap illustrations is one that might be adopted with advantage in the preparation of our local Indian Forest Floras. The first object of such books must be to enable any one, who is interested in the forest, to easily identify the most important species composing it. Armed with this knowledge he then has at his disposal all the available information, botanical, sylvicultural, or economic, which up to date has been placed on record regarding the various species. The knowledge of the

forest thus widely disseminated must not only inevitably result in increasing the exploitation of its products, but, by adding to the number of interested observers, will no less certainly lead to the accumulation of valuable additional facts and information. Such books, which could be quickly and cheaply revised and brought up to date from time to time as knowledge accumulates, will eventually render possible the preparation of a complete Forest Flora of the best type, which would contain in one place, for convenient reference, reliable and practically complete information regarding each species and which would serve as a classic for many years.

Such a book would contain a digest of the principal results obtained by the united labours of the forester, sylviculturist, systematic botanist, ecologist, mycologist, entomologist, chemist and economist, and must be the ideal of every one who desires the true welfare of the forest, or who wishes to acquire any knowledge, other than superficial, of the species which compose it.

SPRUCE YARN.

The expression "mahogany overcoat" used to be employed as a sort of synonym or euphemism for "coffin"; but if things keep on as they have started under the impulse of inventive genius, we may soon hear of "locust-shirts" and "bass-wood collars" and even "long-leaf pine ulsters." The Germans have long since endeavoured to make themselves independent of foreign sources for the various raw materials which they require for their own home consumption, as well as to manufacture for export, and now we hear that there has been made of spruce wood a yarn that is quite spinnable. Whether this is a "yarn" or not, cannot be said, but on the authority of *Der Holzkäufer*, which is many times removed from being a comic paper, and in fact revels in the most wooden of statistics for the foresters and lumber dealers of Germany the formidably named "Aktiengesellschaft fur Garnfabrikation" of Berlin has for some time been having experiments made on the same lines as those which have resulted in the

production of artificial silk and cotton; and the result seems to be gratifying, as spruce is comparatively plenty in the "Fatherland," while as yet (there being no Luther Burbank on her rolls) cotton and silk are not numbered among the productions of Central Europe. The new product is said to have a fine finish and much better surface than is usual with the natural fibres as yet used for spinning. The Technische Laboratorium fur Material-prufungen of the Technical School for Textile Industries in Reutlingen has shown that when leather feed-rolls are used, the new yarn when used as warp or chains is 12½ times as strong as jute; and when used as woof or fillings, 30 times as strong. As against jute, "sylvalin" has the very great advantage of being odorless, even when moist. Articles woven therefrom are naturally not exposed to the attacks of moths. If all these things are true, and the process is not too expensive, there must be a good future for the new yarn, especially if (as is said) it can be worked with all the usual other fibres. The first attempts at weaving have been with wall tapestry, which are most satisfactory in pattern and color, and have the great advantage of being so smooth that dust does not attach itself thereto as readily as to other stuffs used for the same purpose; also, that in brushing them down they do not get rough. So-called Japanese mats have been made of sylvalin, and are hardly to be distinguished from those made of rushes. There is this great advantage on the side of the sylvalin yarn, that it may be woven in the loom; whereas by reason of the shortness of the individual pieces, rushes can be worked up only by hand. The new material has also been made up into cord of various kinds, alone and in combination with other materials, for decorative and other purposes.—[*Scientific American.*]

WHY AMERICAN PRAIRIES ARE TREELESS.

Prof. B. Shimek, of the State University of Iowa, has been studying this question in Iowa, where the treeless prairie originally covered more than seven-eighths of the total area of the State. He finds that the absence of trees is not due primarily to the soil or the topography, nor to such causes as prairie fires, the former abundance of the bison, etc., but is an effect of climate. Moreover, it is not due to a deficient rainfall, so much as to an excessive rate of evaporation. "The prairie areas are uniformly so situated that they are fully exposed to the factors which cause rapid evaporation, namely, the sun and the wind. During much of the year they may present conditions quite favourable to plant-growth, but there are seasons and there are portions of the year, especially in midsummer, when evaporation and consequent dessication become so extreme that only those plants which are especially adapted to dry regions can survive."

PETRIFIED FOREST GIANTS.

Three petrified redwood trees, that have been pronounced the very largest in the world, that have thus far been discovered, have just been uncovered from the *débris* of the mountain-side, only a short distance from the famous Bohemian Club Grove, in Sonoma County, California. This point is near the little town of Occident. One of these pre-historic monsters, that make the pyramids of Egypt modern, by comparison, in their ages, measures 23 feet in diameter and is 350 feet in length. The other two petrified trees are 13 and 12 feet in diameter, respectively. The very largest petrified trees yet discovered, near Calistoga, Sonoma County, California, is only 12 feet in diameter. These three trees lie on a wooded hill pointing due north and south. The petrifaction is most remarkable, the grain of the wood, and in one of them the decaying heat, being very plainly discernible. Surrounding these petrified trees is standing a forest of very large redwoods. However, all of the standing trees are dead. The owner of the land on which these three great petrifactions lie, is now having the *débris* all cleared away, so as to fully expose the giant trunks, and an iron-railing will protect them.—[*Scientific American.*]

FORESTRY AS A CAREER.

The following correspondence may be of interest to our readers, who can form their own conclusions on the subject. These letters appeared in the *Timber Trades Journal*:—

Mr. E. P. Stebbing, Head of the Forestry Department of the University of Edinburgh, writes the following letter to the *Daily Mail*:—

SIR,—All forestry experts are agreed that afforestation in Great Britain will prove a remunerative industry and will tend to keep the people on the land. It may be asked, then, Why does not Government take up the matter on a large scale?

The answer is to be found in the first of the principles drawn up by the Development Commissioners to regulate the applications for grants of money from the public funds for forestry purposes in Britain (omitting Ireland).

The principle reads thus (*vide* First Report of Proc. of Dev. Comm., 1911): "That the first requirement for forestry development is effective education in forestry at suitable centres regulated by organised research and demonstration." Clause 2 reads: "That no scheme of State afforestation on a large scale can be considered . . . until a trained body of foresters becomes available."

Last year you were good enough to grant me a short space in the columns of your valuable paper to enable me to draw attention to the educational advantages Edinburgh University affords for a thorough training in forestry, the University granting a degree in the science.

As a result of your kindness I have received large numbers of letters from parents all over the country asking for further details regarding the Edinburgh course, and also as to what chances there were of the qualified forester obtaining employment when he had secured his degree.

The answer, I venture to think, is to be found in the above extracts from the principles enunciated by the Development Commissioners. We are plainly told that money will be made available

for afforestation purposes when a sufficient body of trained foresters exists. Centres at which this training is given exist.

Edinburgh University, with its unrivalled Science schools, its unique situation, which enables the student to visit extensive, valuable educative woods, both in Scotland and in the North of England (woods non-existent in the south), with its forestry degree and the small cost for which it can be obtained. Edinburgh is admittedly in the first rank of the forestry educational centres of the country.

The centres being there, it remains for the youth of Great Britain to come forward to be trained for a profession at once the most interesting and healthy a Britisher can follow.

TO EDITOR OF THE *Timber Trades Journal.*

SIR,—Professor E. P. Stebbing's letter on the above subject in the *Daily Mail,* which you reproduce in your issue of September 23rd, raises a rather important question for the youth of this country who may be contemplating taking up forestry as a profession. The existence of the Development Grant Fund, with forestry looming largely in the programme drawn up for its expenditure, affords a dazzling prospect of lucrative forestry appointments becoming plentiful in the near future, and many young men, attracted by what Professor Stebbing justly describes as "an interesting and healthy profession," are doubtless turning their eyes in that direction. But do existing circumstances warrant the optimistic views of the Professor, or will they satisfy the prospective students he is so anxious to attract to the academic groves of Edinburgh? That State forestry can be developed in Britain no one doubts. But when the Development Commissioners themselves put "the training of foresters and organised research and demonstration" forward as necessary preliminaries to its initial stages, one wonders where their experience of the subject has been gained. The initial stages of forestry development in the United Kingdom are closely bound up with the purchase of suitable land in large blocks, and its subsequent conversion into forests by the erection of fences, housing accommodation for foresters, draining and preparation of the land, and the stocking of the ground with a few species, which

is to become of them, as they are totally unfitted to take charge of practical work until they have had several years' acquaintanceship with woods worked on commercial lines.

British forestry, such as it is, and very much as it ever will be has been an industry for the last hundred years, and it is little short of nonsense to state that no practical steps can be taken to extend and develop it until a number of raw youths have been passed through the mill of theoretical instruction—useful enough up to a certain point, but which cannot be turned to account unless supplemented by experience in the field of ordinary practice. The fact is that hindrances to forestry development are not a lack of men, or the absence of research, but a refusal on the part of the powers that be to recognise or admit facts concerning British forestry, which have been repeatedly proven on private estates during the last century and which any "research" that may be undertaken will simply and solely prove again.

I am, SIR,
Yours obedient servant,
PRACTICAL FORESTER.

September 26th, 1911.

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EXTRACTION OF TEAK TIMBER IN THE PYINMANA FOREST DIVISION, UPPER BURMA.

[*Contributed.*]

The following are some random notes made a few years ago on the subject of teak extraction in the Pyinmana Forest Division, Upper Burma. Much of the information was kindly supplied by the Assistants of the Bombay Burma Trading Corporation, Ld., to whose timber these notes refer.

The Pyinmana teak forests, it may be mentioned, are situated on hilly country with flats of varying extent, partly on the outskirts of the hills and partly along the main streams. These streams, together with their feeders, form a network of export lines down which logs are floated individually until they reach the Sittang river, where they are made into rafts and rafted down to Rangoon, crossing over on the way from the Sittang to the Pegu river (Pozaungdaung creek) *viâ* the Pegu canal.

Felling, which is carried out chiefly in the rains, is done with saw and axe combined

Logging is done with cross-cut saws. Axes are used only in exceptionally difficult places, where sawing would not be possible. The timber is logged in such a way as to give as much first-class

Photo.-Mechl. Dept., Thomason College, Roorkee.

TEAK LOGS PLACED IN THE UPPER REACHES OF A FLOATING-STREAM WAITING FOR THE NEXT FLOODS—PYINMANA, UPPER BURMA.

timber fit for the English market as possible : thus one English log and two bad logs are better than two medium logs and no English logs.

Dragging, which is done by elephants or buffaloes, is carried out in the rains and on to the end of the cold weather, as little as possible being done after the 15th March. The best season is the rains, the slippery state of the ground facilitating the work ; dragging is in many cases estimated to be three times as easy in the rains as it is at other seasons. To facilitate dragging it was formerly the custom to "snout" logs : this is not allowed now owing to the waste of timber involved, a slight trimming of the corner, to round off the sharpness, being found sufficient. Dragging is greatly facilitated by the construction of what might be termed "corduroy" dragging-paths (Bur. *dahlein-lan*). Billets of wood 4 to 6 inches in diameter are laid across the dragging-path, after the manner of railway sleepers, at distances of about 3½ to 4 feet apart ; these billets are half sunk in the ground, and the logs slide over them with comparative ease.

Carting is substituted for dragging only if the distances are great, special timber carts (Bur. *gindeik*) being employed. Elephants being expensive, it is necessary to save them as much as possible by employing buffaloes for carting. If the distance is not more than 1 to 1½ miles, dragging in the rains is usually found preferable to carting in the cold weather, the season when most of the carting is done.

Elephants can under present conditions of working, where the trees are scattered, drag from 40 to 125 logs from the stump to the floating-stream in a season. The elephants find their own feeding in the forest, and are not fed artificially until after February and then, only if they are working. The food they then receive is paddy.

Buffaloes as a rule drag smaller sized logs than elephants, but with the aid of the special corduroy dragging-paths described above large teak logs of as much as 4 tons are dragged by teams of 2 or 3 or even 4 pairs of buffaloes. The buffaloes are yoked together in pairs, the yokes being long poles 6 or 7 feet in

length. One pair pulls in front, the dragging-chain being fixed to a drag-hole (Bur. *napa*) cut in the top corner of the log. The dragging-chain is kept short, so that the buffaloes can slightly lift the front of the log. The rear pair of buffaloes, one on either side of the log, have their chain fastened either to another drag-hole at the rear top corner of the log, or to a wooden peg driven into the end of the log, at its centre. The intermediate pair or pairs, one animal of each pair on either side of the log, have their chains fixed to upright pegs driven tight into holes, 1 inch in diameter and about 3 inches deep, drilled into the log. In narrow places the rear pairs of buffaloes can be brought forward and harnessed in front of the leading pair. Buffaloes work best in the rains; they cannot stand hot dry weather, while on metalled roads their feet give out. Hence where carting is done they are employed only in the shade of the forest, the carts being taken over by bullocks where open country or metalled roads are reached.

Floating.—Where the floating-stream is very narrow the logs are placed in the direction of the stream; otherwise they may be placed in any position. Plate I shows a number of teak logs placed in the upper reaches of a floating-stream waiting for the floods of the next rains. The earliest rises usually occur in the middle of June; these, however, are not regular. September is the best floating month; August is generally not so good, there being frequent breaks in the rains. A rise of about 6 feet is sufficient to float the largest logs: anything above 12 feet is bad as the logs are apt to become stranded on the banks.

During the floating season gangs of elephants are kept in readiness along the streams waiting for rises, and as soon as these occur they go into the water and keep the logs in the stream, rolling or pushing them into the current whenever they show signs of standing. This work, known as *aunging*, is very necessary in order to prevent *taiks* or jams of logs, the removal of which, if they form, may be a difficult and dangerous operation.

Prevention of loss in transit.—During the cold weather, chiefly from December to February, elephants are sent down the streams

then nearly or totally dry, and logs stranded in the jungle and tall grass along the banks are searched for and rolled or pushed into the bed of the stream. This operation is technically known as "*aunging* drift," and timber left stranded in the streams after the floating season is over is known as "neaped timber." Plate II gives an idea of a typical floating-stream in December, with neaped logs lying in it. Fire-watchers patrol stretches of the streams in the dry season, to keep fire off the stranded logs. The chief danger of loss lies in the silting up of logs. These buried logs are sought for and dug up; if they have been buried for any length of time they require to be left for two years to dry before they will float again.

Rafting in the Sittang river.—The logs are collected and formed into rafts at the mouths of the floating-streams, where these enter the Sittang river. In small streams like the Yeni a chain of floating teak logs, or a fixed boom of pyinkado posts, will stop the logs. In the larger and more powerful streams, like the Yônbin, booms are not employed, since even if the posts holding them are not torn up the banks become eaten away by the current: in such cases the logs are collected singly by swimmers or men in dugouts. The Sittang rafts require to be narrow, in order to pass through the Pegu canal lock gates: they contain 40 to 60 logs, as compared with about 120 logs in an Irrawaddy raft. Three men accompany each raft. The rafting season lasts from the beginning of September to the middle of November, there being insufficient water in the river at other seasons.

A SHORT PRELIMINARY NOTE ON THE SUITABILITY OF THE DEAD WOOD OF *ACACIA CATECHU* FOR KATHA-MAKING.

BY PURAN SINGH, F.C.S.

Under cover of his letter No. C.-1696 of 1910, the Conservator of Forests, Southern Circle, Madras, forwarded a report from the Range Officer, Coondapur, District Canara, on the unsuitability of dead tree of *Acacia Catechu* for Katha-making. The

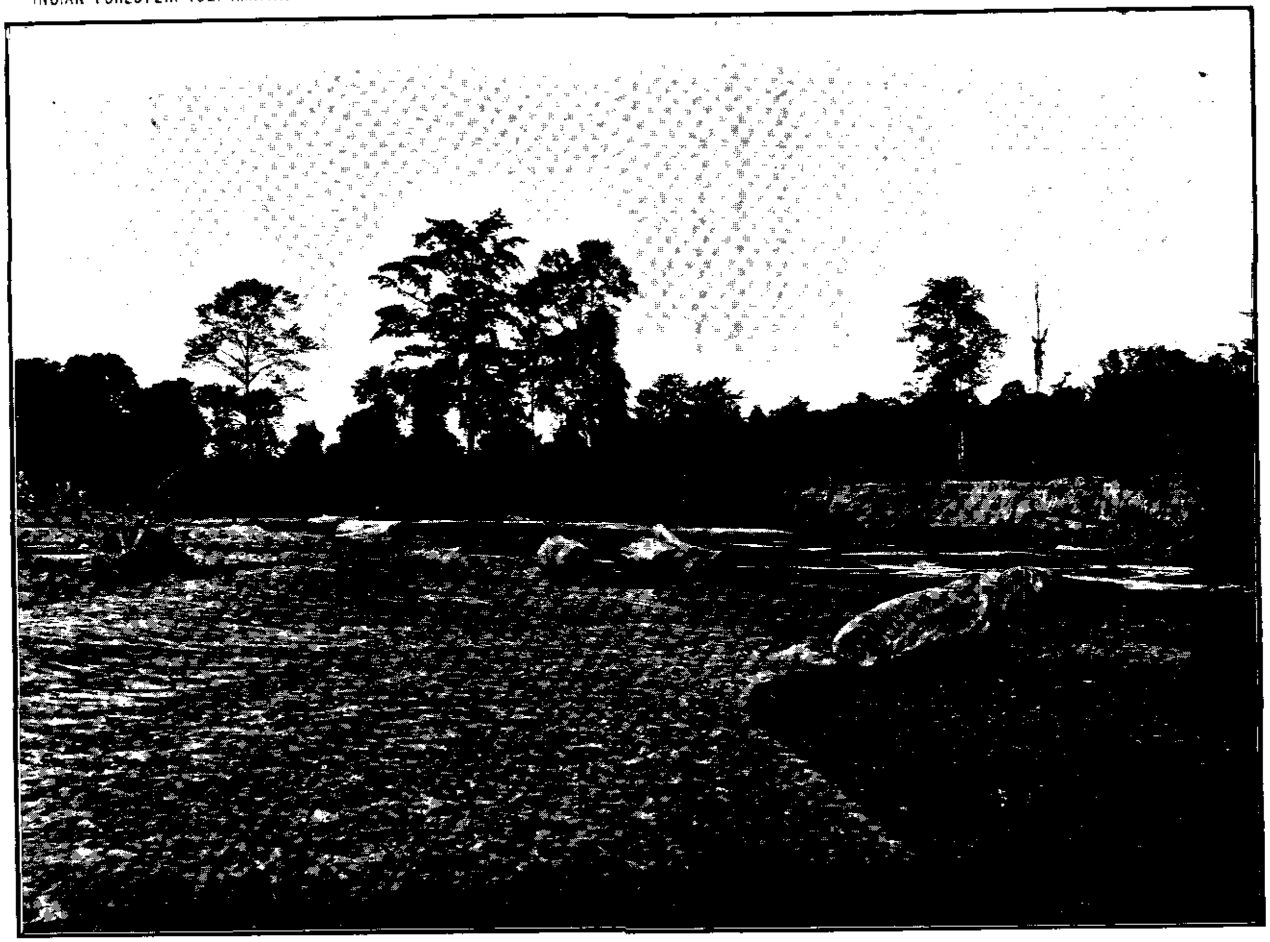

Photo.-Mechl. Dept., Thomason College, *Roorkee*.

HEAPED TEAK LOGS IN A FLOATING-STREAM, PYINMANA, UPPER BURMA.

fact pointed out by the Ranger was worth a thorough enquiry. Accordingly, a sample of the wood from a dead tree of *Acacia Catechu* from Madras was received for examination. To see if the heart-wood of dead trees differed in any way from that of the living tree, two specimens of the heart-wood, one from a naturally dead tree and the other from a tree killed *in situ* by girdling were also examined. The following table embodies the results of the examination :—

Description of the sample.	Moisture, per cent.	Aqueous extract, per cent.	Alcoholic extract, per cent.	Catechu, per cent.
1. Heart-wood of dead tree from Madras ...	8·23	12·72	9·76	2·56
2. Heart-wood of dead tree from the Siwaliks ...	9·58	16·40	12·38	1·48
3. Heart-wood of a tree killed *in situ* by girdling from the Siwaliks ...	17·50	12·05	10·18	4·02

The percentage of catechin from the wood of both the trees which had died naturally, which had been standing for a considerable time in the forests, and which had therefore been exposed to climatic influences was very low ; their wood must therefore be pronounced as unsuitable for katha-making. The cause of it being unsuitable for the extraction of katha is not due to the death of the tree, but to the anhydration and oxidation after death. By a series of experiments I have arrived at the fact that if the heart-wood is kept for a prolonged period after felling, this has an injurious effect on it as far as its suitability for extracting catechin is concerned. A specimen that in 1907 had 10·9 per cent. of catechin, 13·7 per cent. of alcoholic extract and 21·8 per cent. of aqueous extract, showed in 1911 only about 8 per cent. alcoholic extract and about 8 per cent. of watery extract, catechin *nil*, and had most of the tannin oxidised into catechu-red. The wood had become useless as a katha or cutch-producing material. The tree killed *in situ*, in spite of its having been dead for some months, still showed white deposits of Keersal and gave

a fairly average composition, though it, too, had lost a small percentage of its catechu tannin.

The conclusion which I arrive at is, that it is not the actual death of the tree which makes the wood unsuitable for katha-making, but the effect of long exposure. Briefly speaking, the effect is one of anhydration and oxidation due to the "weathering" of the wood. Catechin first oxidises into catechu tannic acid which further is oxidised into catechu-red.

"PODOPHYLLUM EMODI."

BY PURAN SINGH, F.C.S., CHEMIST TO THE FOREST RESEARCH INSTITUTE.

Podophyllum is a small herbaceous plant belonging to the family *Berberidaceæ.* There are in all four species of this plant known. *P. peltatum* grows in North America. It is this species which is at present the chief source of the popular purgative podophyllin. *P. emodi* (Wall) grows in Northern India and also in Tibet and Afghanistan. This species has, comparatively speaking, only recently attracted the notice of the scientific world and its claims to be included in the British Pharmacopœia are now being considered. The other two species, namely, *P. pleianthum* (Hance) and *P. versipelle* (Hance), are met with in China. They are only of botanical interest. The Reporter on Economic Products first noticed this plant in Kulu, during a botanical trip there in November 1888. It was afterwards found in Garhwal, Kumaun, Chamba and the hills near Simla, Kashmir and Hazara. It is also met with in Sikkim, Tibet and Afghanistan. The plant grows less plentifully in the eastern part of the Himalayas than in the western and central parts of the range. It does not occur below an altitude of 6,000 feet and generally is only found at an elevation of 8,000 to 9,000 feet though sometimes up to 15,000 feet. Though the plant is met with in Garhwal, and north-west of Simla in the Shalai and other hills, it is most abundant in the western hills of Simla and in Kumaun, in Chamba and Kulu where the hill slopes are often practically covered with it.

DESCRIPTION AND HABITS.

As mentioned above, it is a herbaceous plant rarely attaining a greater height than one foot. The root system is perennial and it consists of one rhizome with numerous thin rootlets branching off from it. Above it is the succulent stem growing annually and bearing from one to five leaves according to the age of the plant. The plants generally appear in April and die down in November. The leaves usually appear when the stem has attained a height of 6" to 12", and hang umbrella-like on either side of it. It flowers in May and the flower is white with a pinkish tinge. The fruit ripens about August and September. It is of the size and shape of a small lemon. Attempts are being made to cultivate this plant and it has been observed that it can be grown from sections of the rhizome as well as from seed, but the former method generally takes a longer time than the latter. It grows two years after planting the sections but it is only after the fourth and fifth year that the rhizome is fit for collection.

ITS MEDICINAL PROPERTIES.

As in the American species the active principle is found only in the rhizome and rootlets branching off from it. The resin extracted from the rhizome is an hydragogue cathartic in large doses and an alterative in small. The activity of the resin depends on the chief active principle called *podophyllotoxin*. From its vernacular name *papra* or *papri*, also *bhavan bakra* or *bakara* which are given in the new *Pharmacographia Indica*, it is supposed that it was one of the bile expelling plants known to Sanskrit writers under the name *Paprati*. In Chamba and Kulu they are known as *Gulkakri* or *Bhavan kark* respectively. The similarity in names shows that the same property is attributed to it. In some places indeed it is used as a jalap. It is known to have a specific action on the liver causing an increased secretion from the bile. But unlike jalap, if taken by itself it causes severe griping and pain and is thus rarely used. In some cases it serves the same purpose as calomel.

ITS CONSTITUENTS AS COMPARED WITH THE AMERICAN SPECIES.

The Reporter on Economic Products, when he first noticed this plant in 1888, at once thought of having it chemically examined to determine if in its constituents and their medicinal properties it would compare favourably with the American species. Accordingly, he sent some roots to Dr. Dymock of Bombay for chemical examination who, in conjunction with Mr. Hooper, instituted a comparative examination of the two species and reported that the Indian species contains more than twice as much podophyllum resin as the American. According to Mr. Hooper, *P. emodi* contains 12 per cent of the resin whereas the other contains only 4 per cent, and both are similar in their physiological activity. In 1898 Professor Dunstan, together with Dr. Henry, made a complete investigation into the chemistry of both the species. *P. peltatum* had already been examined by many chemists, but it was Podwyssotski (Pharm. Journal, iii, 7, 12, 217, 1011) who made the first important contribution on the subject.* He proved that the resin did not contain any alkaloid such as berberine. He obtained three substances *Podophyllotoxin*, *Podophyllic acid* and *Podophylloquercetin*. He also showed that when *podophyllotoxin* is acted on by alkalies, it is converted into two new substances *Picropodophyllin* and *Picropodophyllic acid*, the former of which is crystalline and the latter gelatinous. Kursten amplified on this work and obtained *podophyllotoxin* in a crystalline form and believed that along with the isomeric *picropodophyllin* formed by the action of alkalies on *podophyllotoxin*, an oxidation product is formed which is gelatinous and is identical with Podowyssotski's *picro-podophyllic acid.*

Dunstan and Henry give the following constituents of *P. emodi* and prove that *P. peltatum* is identical with it in composition. According to them the crystalline *podophyllotoxin* has the composition $C_{15}H_{14}O_6\ 2H_2O$. When acted on by aqueous alkalies it is converted into its isomeric compound *picro-podophyllin.* It was also shown that both the above-mentioned isomers contained two methoxyl groups. They also isolated the podophyllic acid to

* See Imperial Institute Technical Reports and Scientific Papers, 1903.

which they assigned the formula $C_{15} H_{16} O_7$. The yellow colouring matter was also carefully separated and purified. It was shown to have the formula $C_{15} H_{10} O_7$ and to yield a pentacetyl derivative melting at 192°C. This substance is identical with *quercetin.* But even after *picropodophyllin* and *podophylloquercetin* has been removed a dark brown resin is left behind. It is amorphous and completely soluble in alcohol. This was also shown to be physiologically active though not so irritating as *podophyllotoxin* which cannot by itself be used as a medicine. To sum up *Podophyllum emodi* like *Podophyllum peltatum* contains the following substances:—(1) *Podophyllotoxin*, (2) *Podophyllic acid*, (3) *Podophylloquercetin* and (4) *Podophyllum resin.* *Picropodophyllin* is not a constituent of the herb but can be prepared from *podophyllotoxin* and is an isomer of it.

COMPARATIVE ESTIMATION OF PODOPHYLLUM RESIN AND PODOPHYLLOTOXIN IN TWO SPECIES.

Hooper and Dymock were the first to make a comparative estimation of the amount of resin in the two species. According to them the percentage was about 11 per cent in the Indian species and 4 to 5 per cent in the American one. Umney found the percentage to be 12 per cent in *Podophyllum emodi.* Dunstan and Henry found 9—12 per cent of resin in the Indian root and 4—5 per cent in the American. They also showed that the Indian drug contains 2—5 per cent of *Podophyllotoxin* while the American contains only ·8 to ·9 per cent. In regard to the variation in the resin per cent of the Indian roots, it may be mentioned that the writer had the opportunity to examine samples of *P. emodi* roots from different localities collected in the different seasons and he has shown (see Forest Bulletin No. 9) that the percentage of resin in the Indian roots varies from 10 to 20 and that of the toxin in the resin from 25 to 50 according to the locality and the season of collection, and it is safe to assert that an average sample of the Indian root will contain, as a rule, twice as much of the active principle as the American. It has also been determined that the best season for collection is May, when the herb is in flower. In

order to obtain the Indian drug of standard and regular composition, it is essential that it should be cultivated and collected under similar conditions in a systematic manner. It is gratifying to note that the Forest Department is looking into the experimental cultivation of this valuable drug.

Doctors Mackenzie and Dixon of St. Thomas Hospital have made a comparative investigation of the medicinal properties of these two herbs and proved that the resin from *P. emodi* is as good a purgative agent as that obtained from *P. peltatum* when administered in small quantities but acts more powerfully when given in large doses. The chief physiological and therapeutical properties of the various constituents of the herbs can very well be understood from the following statement of the authors :—

> "That Indian Podophyllin is an active purgative and a useful therapeutic agent; that it may be substituted for *P. peltatum.* But it is important that the physician should know which sample he is prescribing, as the Indian variety is nearly twice as physiologically effective as the American. That the active principles contained in the crude resin are two substances—(*a*) Crystalline *podophyllotoxin ;* (*b*) *podophyllo-resin,*—both of which act as excellent laxatives in small doses, without secondary constipation or other objectionable symptoms."

> "That although both these substances act very similarly on the alimentary tract, it is only the podophyllo-resin which exerts a true cholagogue effect, which shows itself rather by a large increase of the solids secreted than by an increased quantity."

> "Both exert their specific activity when injected hypodermically in alcoholic solution, but in man so much irritation is produced as to forbid their employment in this manner."

It has been shown that the rhizome of *P. emodi* of India is twice as active as that of the American *P. peltatum.* They are identical in their chemical composition and in their physiological

and therapeutic properties. All scientific authorities are unanimous in their preference of *P. emodi* as a medicine to *P. peltatum*, though exception is taken in certain quarters as to the constancy of its composition. It has been pointed out that this difficulty can be overcome by artificial cultivation of the rhizome under uniform conditions.

It has been included in the Addenda of the British Pharmacopœia, but it has not yet got its due place in the B. P. official list, and because of this want of full recognition, it does not fetch at present a remunerative price. For example, a Calcutta exporter obtained only 34 shillings per cwt. c. i. f. London for rhizome containing 13 per cent of this resin. This rate is extremely low considering the superior quality of *Podophyllum emodi*. At this rate, it is hardly worth while to cultivate it or even to collect it. It may not be therefore out of place to draw the attention of the Committee appointed for the revision of the British Pharmacopœia to the claims of *Podophyllum emodi* for inclusion in the revised edition.

The price of the Podophyllin or the Podophyllum resin obtained from the American plant is about 9 shillings per lb. in London. The Indian rhizome contains about 11 per cent, and 1 cwt. of it would give about 12 lbs. of the resin worth 108 shillings. Once it becomes fully recognised by the B. P., it will be worth while to manufacture the Podophyllum resin in India and thus realise its full value instead of exporting the rhizome at 38 shillings per cwt. as at present.

THE REPORTER ON ECONOMIC PRODUCTS.

The following is the text of the Government of India resolution on the abolition of the post :—

From the 1st of February 1912 certain changes will be made in the duties of the Reporter on Economic Products to the Government of India and that officer will be transferred to the Botanical Survey of India with the title "Economic Botanist to the Botanical Survey." Communications such as have hitherto

been made to the Reporter on Economic Products on the subject of animal medicinal products, wool, leather, tea and cinchona should in future be addressed to the Director, Botanical Survey, Royal Botanic Garden, Sibpur, Calcutta. Similar communications in respect of forest matters should in future be made to the Director, Forest Research Institute, Dehra Dun; in respect of agricultural matters to the Director, Agricultural Research Institute, Pusa; and in respect of geological matters to the Director of the Geological Survey, Calcutta.

REVIEWS.

A RESEARCH ON THE PINES OF AUSTRALIA.

[By R. T. Baker, Curator and Economic Botanist, and H. G. Smith, Assistant Curator and Economic Chemist, of the Technological Museum, Sydney, published by authority of the Government of New South Wales, Sydney, 1910, as No. 16 Technical Education Series of the Department of Public Instruction. Price not stated.]

1. This is a handsome royal quarto volume of 458 pp. printed on heavy glazed paper and profusely illustrated with well over 300 figures, many of which however are not numbered. The work, the results of which are included in this volume, was undertaken with the object of ascertaining the extent of the commercial possibilities of the conifers of Australia. The plants dealt with comprise—*Callitris* (18 sp.), *Actinostrobus* (2 sp.), *Diselma* (1 sp.), *Microcachrys* (1 sp.), *Athrotaxis* (3 sp.), *Araucaria* (2 sp.), *Agathis* (2 sp.), *Dacrydium* (1 sp.), *Pherosphæra* (2 sp.), *Phyllocladus* (1 sp.), *Podocarpus* (5 sp.) and the word *Pines* in the title of the work consequently strikes one who is not familiar with the local vernacular names of the species as somewhat inappropriate.

2. So far as the information and materials available rendered possible, each species has been dealt with under the heads of habitat; systematic description; economics, anatomy, chemistry of products of leaves, fruits, timber and bark; and forestry. The

authors were assisted in their work by the officers of the Department of Public Instruction and much of the information included regarding the distribution of the various species and other points was obtained from the Public School Teachers of the State. An appendix gives the names of no less than 250 correspondents (chiefly Public School Teachers) who assisted in collecting data for the work. In addition to the material obtained from New South Wales specimens were also obtained, to some extent, from other parts of Australia and the principal European herbaria were also consulted.

3. Among the more important species dealt with may be mentioned :—

Callitris glauca (White Pine) attaining a height of over 100′ with a diameter of 2′–3′. Yields a good building timber which, in company with that of other species of the genus, is but little attacked by white-ants, probably on account of a phenol contained in the wood to which it owes its characteristic odour.

Callitris calcarata (Black Pine) attains 60′–80′. Yields an ornamental and good building timber and also a valuable bark for tanning.

Araucaria Cunninghamii (Hoop Pine) attains 200′ and a girth of 22′—23′. Largely used for all kinds of indoor work.

Araucaria Bidwilli (Bunya Bunya) attains 150′ and yields a timber valuable for indoor work.

Agathis robusta (Queensland Kauri) attains 150′, and yields an excellent timber for joinery and commercial oil of turpentine.

Podocarpus elata (Brown Pine) attains a height of over 100′ and yields a valuable wood for joinery which is said to resist attacks of teredo and white-ants.

4. The authors have done excellent work in bringing prominently to notice the urgent necessity for an energetic and scientific forest policy in Australia which, while arranging for the prompt utilisation of the valuable species, would also insure a permanent and sufficient supply of the same. In the case of practically all the important species there is apparently the same sad story of destruction and want of provision for the future. Thus of the valuable Hoop Pine we read that "forty years ago the ridges

on the Lower Richmond were covered with what appeared to be an inexhaustible supply. A saw-mill to cut up the pine was started at Lismore about 1856 followed by several others at different parts of the river. * * As a natural consequence, at the present time, this pine is rapidly becoming a tree of the past on the Lower Richmond."

Of the White Pine that "they are getting scarce near the towns owing to the great demand for this timber, and the thoughtless destruction of young trees" and that "the supply of this most useful timber is gradually becoming less and less, and no steps are being taken for its propagation." Of the Brown Pine in New Italy we read that "this species is, unfortunately, almost extinct, the only specimens being saplings of very little value. It grew in profusion about the Williams River long ago."

Of the Kauri that "it has always been regarded as the most valuable of Queensland pines, but it is unfortunately becoming scarce," while the authors rightly note that "the present policy of indiscriminate destruction of Australian vegetation, now going on all round us, is to be deplored, and we raise our voices in protest; while, on the other hand, we would indeed welcome a vigorous policy in the opposite direction."

We are glad to see that in the authors' opinion successful afforestation depends on an ecological study of the species concerned "because it must certainly be more judicious and scientifically correct to plant those trees which are most suited by habit and constitution to the situation and soil required to be utilised, than to deal with the matter in a haphazard way."

5. The authors have brought together a large quantity of valuable economic information regarding the distribution of the various species, more particularly with reference to New South Wales, and the economic products yielded by them which include timber, perfumery oils, turpentine, tanning-material and sandarac. While we are in full sympathy with the contention that pure science forms the foundation on which applied science must be based, we cannot but feel that the present book would have better served its purpose of assisting "the development of the natural resources

of Australia," which the authors state has been their incentive throughout, if more care had been taken to give prominence to facts of obvious practical interest and importance and to prevent these being obscured by detail of purely scientific interest. Thus the ordinary reader naturally wishes in the first place to be able to identify the species with certainty which have been dealt with. He will however find no concise key, based on easily recognisable morphological characters, to help him in quickly discriminating closely related species, and although there is a profusion of figures illustrating the anatomical structure of several species, of others there are no figures at all. The business man, also, who is on the look out for information regarding the products of known, or probable, commercial value, and for facts which will help him to decide whether or not a paying industry can be established, will find himself impeded by much detail of purely botanical or chemical interest.

6. The key to the lines of work followed and method of publication adopted is apparently to be found in the authors' faith regarding the capacity of anatomy and chemistry to aid in systematic work, to help in the definition of species, and in indicating their relationships and their course of evolution. In our opinion the primary object of the systematist must be to define, and to assist field-workers to identify, plant-groups which actually occur as distinct and readily distinguishable entities in the field and the definition of the systematic species must therefore depend on morphology alone. In this work of definition the pioneer must be the herbarium systematist, but no species can be regarded as finally established until the work in the herbarium has been exhaustively tested in the field by the field systematist and ecologist. A species founded on morphological characters alone which has passed the test of both the herbarium and field-botanist must be considered as having been finally determined, and classification thus arrived at should not be influenced or upset by a consideration of different sets of characters, anatomical, chemical, or otherwise. Granting this, it will be at once conceded that anatomy and chemistry may both subserve a valuable if only

subordinate roll in systematic work inasmuch as they may be the means of drawing attention to morphological characters which had hitherto been overlooked and may provide additional characters which are always correlated with morphological differences, by the aid of which the accurate identification of incomplete specimens and of the products of plants may be facilitated or rendered possible, while the help of these branches of knowledge is of course indispensable if we wish to elucidate problems of plant-nutrition or to realise the full economic benefits to be derived from vegetation. The lack of a clear understanding of what is to be regarded as a species and of a clear recognition of the part which field-study and ecology must play in the final determination of species and in the accurate definition of the boundaries of plant-groups which the herbarium systematist can only indicate approximately and tentatively, we regard as desiderata of the first importance in modern botany. Until a general understanding is arrived at regarding them, it seems impossible to hope for a time when nomenclature and classification shall crystallise from their present state of flux, shall present for the use of the practical man and economic worker adequately defined and finally named plant-groups, in the place of elusive forms with ever-changing names and varying characters, and shall provide a firm foundation on which the problems of the relationship and evolution of the various forms can be undertaken with some prospect of success, rather by an experimental study of the variation and heredity of living plants than by a search for correlated characters and theorising on herbarium material.

7. This being our view we are naturally disappointed to find that the authors, who were apparently able to study their plants in their natural habitats, have not found it possible to pay more attention to ecology. The details given in the book, for instance, do not indicate that the field-study has been sufficient for an accurate or permanent definition and classification of the various species. The authors themselves point out that a wide geographical area by no means necessarily connotes considerable differences in environmental factors, and consequently a species which appears

constant from isolated gatherings in widely separated localities may prove to be variable and to present numerous intermediates, if care is taken to study it in localities where there is a considerable difference in such important factors as soil, available moisture, light, proximity of nearly related species, and so on. To discover and explore such localities and to deal satisfactorily with the intermediates that may be met with is the special function of the field-botanist and ecologist and until this work has been done the classification cannot be regarded as final. From the quotation with which the authors aptly close their book it is clear that they do not consider their work as finished and we trust that they will supplement the valuable work that they have already done on the Australian Eucalypts and Conifers by a careful ecological study of the species dealt with. When this has been completed, we would suggest the issue in handy form of a concise summary of the chief results obtained which would aim at (1) facilitating as far as possible the ready identification of all the species finally established, and (2) giving prominence to all facts of undoubted practical importance, those of purely scientific interest being omitted.

8. While therefore the book seems to us to be to some extent open to criticism, we must record our unstinted admiration for the industry and skill with which a mass of valuable information has been collected, which cannot fail to be of interest to the botanist, chemist, forester and commercial man and which makes the book indispensable to anyone interested in the forest vegetation of Australia.

A feature of the book which deserves special attention is the successful employment of natural-colour photography for the reproduction of stained micro-sections.

PROBATIONARY SERVICE OF EXTRA ASSISTANT CONSERVATORS OF FORESTS PROMOTED FROM THE SUBORDINATE FOREST SERVICE TO COUNT FOR INCREMENTS UNDER THE TIME-SCALE OF PAY.

We are permitted to publish the following extract from a Government of India order on the above subject :—

" The intention was that the probationary service of an Extra Assistant Conservator of Forests promoted from the Subordinate Forest Service, but not that of an officer appointed direct, should be treated as qualifying for increments under the time-scale of pay sanctioned for the Provincial Forest Service and to state that the Government of India are pleased to rule that an officer promoted from the Subordinate Forest Service to the Provincial Forest Service shall count all periods, whether continuous or broken, of probationary service as Extra Assistant Conservator of Forests. towards increments under the time-scale of pay."

SUBSTITUTE FOR HARD RUBBER &c.

His Majesty's Consul at Philadelphia (Mr. W. Powell) has furnished a report on a *new material*, manufactured by a secret process and stated to be a *substitute for hard rubber, cork, horn,* etc. The manufacture is claimed to be simple and cheap. The material is stated to be made mostly of bye-products or waste substances, indeed of anything that contains vegetable fibre, such as horse-dung, cow-dung, waste paper, hay or straw that is unsuitable for fodder, shavings, etc. It is claimed that the material can be turned out with a profit at 4½*d.* per lb. Exhaustive tests made in the United States show,it is stated, that electrically it is equal, if not superior, to hard rubber, fibre, porcelain, cork, horn, etc., and would take the place of these materials in several of their uses. Its power of resisting heat is said to be almost if not quite equal to that of asbestos, and it is extremely tough and very difficult to break. In its first stages of manufacture, being perfectly plastic, it can be moulded into any shape desired.—[*The Indian Trades Journal.*]

THE FALLING OF FRUIT FROM THE TREE AND ITS CAUSES

The conditions which bring about the falling of almonds and apples, apart from windfalls and the effect of insects, is worth the careful consideration of fruit growers. A good deal of loss is caused by these fruits falling when about the size of a hazelnut. Scientists attribute the occurrence to one of two causes, *viz.*, to incomplete fertilisation, or to insufficient nourishment, or both.

Professors Muller and Osterwalder have been engaged in studying and testing the truth of these suppositions in one of the experimental stations of Germany. The former confined himself to the almond tree. Of the fruit which fell on the ground 10 per cent were found without seed and only contained traces of germination ; 30 per cent contained only one seed and 9 per cent contained shrivelled embryos. Whereas, on the contrary, the fruit which remained on the tree had many seeds and though one of them contained only one seed, not a single fruit was found

entirely seedless. The investigation was regarded as proving that the falling was due to imperfect, or total absence of fertilisation.

In 1906 Prof. Osterwalder extended his researches to eight varieties of almond trees and to four varieties of apple trees. The fruit was collected either by gently shaking the boughs (dislodging the ripened fruit) or by picking. All the fruit so obtained was found to be fertilised and no material difference was observed in the number of the seeds contained in each of these groups. The alternative assumption, *viz.*, insufficient nourishment, was held in this case to have been the cause of any premature falling that might occur.

The treatment to be applied depends upon which of these two causes is at work. To ascertain this, cut the fruit across and examine the two halves. If there is no seed or if it is imperfect it may be assumed that fertilisation has been defective, owing, probably to the absence of pollen of that variety. To remedy this, blossom-bearing trees should be planted near. On the other hand, if one or more seeds are contained in each fruit, it may be taken as a sign that although fertilisation is satisfactory nourishment has been lacking and in this case manure, either khan or chemical, should be worked into the soil.--[*Cyprus Journal.*]

INSTINCT IN ANIMALS.

Herbivorous animals evince an almost unerring instinct in avoiding poisonous plants, even those which, to the human palate, would fail to betray their noxious properties. Monkeys may nibble at an unknown fruit, but they generally pause to study the result of that test, and nearly always manage to arrive at a correct conclusion.

Such facts suggest a sagacity which seems to indicate the existence of a "sixth sense." The ordinary senses of our fellow-creatures, says the *Philadelphia Record*, may receive warnings from indications which we have not yet learned, or else have forgotten to heed. The Superintendent of the Meteorological Observatory at San Salvador noticed with surprise that both the beasts

and the agricultural Indians of the neighbouring mountains seemed to recognise the omens of an earthquake which he himself would have been unable to predict without the aid of his barometer.

"There will be a temblorito (a little shock) before long," the Indians would remark, in the matter-of-fact way with which a person might comment on the probability of a rain shower. "What makes you think so?" he would ask the prophets. "Is there anything unusual about the weather or the looks of the sky?" "Don't know," was the invariable reply, "but I have felt that way before every earthquake."

The weather, at such times, might appear clear and calm; perhaps even cooler than usual; but soon after sunset the predicted temblorito would rattle along the streets, and shake the loose rocks from the cliffs of a neighbouring quarry.

In the reign of the Emperor Justinian, the coasts of Western Asia were visited by a series of destructive earthquakes, and a few days before the first shock the citizens of Antioch are said to have received a warning of its coming in the sudden departure of a large flock of rooks that had long made their nests in the city walls. The credibility of that seeming miracle has often been questioned; but is it not possible that experience may have taught the birds to connect certain conditions of the atmosphere with the idea of an impending 'quake?

Capenter mentions the case of a wren that built her nest in the slate quarries of Penrhyn in a situation liable to great disturbance from the occasional explosions. She soon learned, however, to take warning by the sound of the bell, which was rung to give notice to the workmen whenever a blast was about to be fired, and would quit her nest and fly to a little distance, where she would remain until the shock of the explosion had passed off.

Storms, too, are thus evidently anticipated by various species of animals and birds, and it is by no means inconceivable that even their supposed ability to forecast the approach of mild or severe winters may be in some measure a fact.—[*Indian Field.*]

CURIOSITIES IN FRENCH FISHING TACKLE.

French manufacturers of fishing tackle offer their customers a great variety of novel and ingenious implements: some of the devices are so curious, that a short description may interest angling readers of the *Indian Field.*

A cross-bow specially made for harpooning fish, appears to be a most ingenious toy, from which one might get a good deal of amusement. It has a wooden bow, which, however, does not bend as in ordinary cross-bows; the impulse to the harpoon is given by thick elastic strings. The arrow is a light tube made of fibre, with a steel head. The line runs down this tube to a reel, which is fixed underneath the barrel of the cross-bow. The makers declare that this instrument shoots with considerable accuracy, and that with its assistance one can capture fish of considerable size, when they are lying on or near the surface.

A terrible looking instrument in the harpoon-gaff; a set of claws gape at the end of the shaft, and on thrusting the contrivance down on to a fish the claws seize hold of it like the talons of an osprey. A French tackle shop offers, as might be imagined, a great assortment of fishing creels, for most of the baskets sold in England are of French make. Consultation of a Saint Etienne catalogue also shows that English sellers make an enormous profit on these foreign creels.

There seems to be a considerable demand among Continental anglers for artificial insects, judging by the numberless ingenious imitations which are offered for sale. Besides caterpillars, spiders, grasshoppers, beetles, and so forth, they make artificial gooseberies and cherries. You can also buy imitation mice and crabs, and frogs which work their legs in life-like manner, as they are drawn through the water.

An extraordinary fishing instrument is the floating reel. A reel is fastened to the top of a sort of little boat, while the angler carries a larger winder full of line. The boat can be made to sail out into the middle of a river, and let out the baited hook from its reel. The apparatus is, of course, an application of the otter principle, and

anyone using such a device on British waters would certainly be run in for poaching.

A peculiarly ingenious device of very questionable utility, is a combined rod and reel. The rod is in four pieces ; the top and two middle joints being of split cane, while the butt is a metal tube. On the butt are two grips, with a reel, permanently attached to the rod, between them. The upper grip glides backwards and forwards like the fore-end of a Winchester repeating shotgun. This to and fro motion winds in the reel, so that when you want to shorten line, you pump the upper grip to and fro. The paying out of line is regulated by a small lever worked by the thumb.

There is also an automatic reel made in France, which strikes the fish on touching a lever, or, if preferred, when bottom fishing, the reel can be arranged to strike the fish directly there is a pull at the bait. As the catalogue says, the angler, after resting his rod over a twig, can go off and smoke his pipe quietly, or take a siesta, and the reel does the rest.

For casting long distances, a reel is made to twist through a right angle, like the well-known Malloch. The French edition is, however, made in wood instead of metal, and looks very like an ordinary Nottingham wooden reel. The handles being fixed to the drum, the latter cannot be reversed, as in the case of the Scotch reel.

A very good system of stiffening light cane bottom rods is carried out in France. A fine silk ribbon is wound spirally round the cane, and then a similar ribbon is wound with the spirals in the opposite direction, both ribbons being varnished and covered at their ends by the ferrules they cannot ever become loose. This plan adds great stiffness and strength to light roach canes, without appreciably increasing their weight.

French tackle shops sell an enormous variety of made-up baits. Some of these pastes are scented with all kinds of odorous substances. One can even buy desiccated blood for bottom fishing.—[" *Fleur de Lys* " *in the Indian Field.*]

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THE NEED OF FIRE-PROTECTION IN THE TROPICS.

INTRODUCTION.

The present paper has been inspired by the great diversity in opinion that seems to exist among Forest Officers regarding fire-protection in the tropics. The views of the growing " too much fire-protection " school of Burma have been freely expressed and it seems time that a comprehensive review of all that has been written on the subject should be compiled. The present writer has endeavoured to collate these detached papers, not only from the pages of the *Indian Forester* but from all other publications in which he could find any statements bearing on the question.

As far as could be ascertained, nowhere outside the Indian Empire has the harmfulness of forest fires been questioned.

The present paper purports to quote, first, a few extracts showing the value of fire-protection in India, then at considerable length the arguments on which the opposite theory is founded, and then to discuss the evidence *pro* and *con,* closing with suggestions for general conclusions.

The writer has endeavoured to confine himself mainly to quoting what others have written, and for this reason offers no apology for somewhat lengthy extracts.

Before proceeding to the subject matter it will not be unprofitable to trace out the earliest record of protest against fire-protection. It is supposed by some that Mr. Walker first raised the question from Burma, but Mr. Slade, also a Burma officer, wrote to the same effect much earlier—1896.

But earlier still we find in the pages of the *Indian Forester* contributions from the pens of Mr. Porter from the Madras Presidency in 1894,* and Mr. Dickinson from Coorg in 1883,† both complaining of the absence of teak seedlings in fire-protected forests.

Even before these officers, however, as pointed out by the late Mr. W. E. D'Arcy‡, Captain Forsyth, in his "Highlands of Central India," argued that fires were beneficial to teak forests and assisted reproduction, and that by keeping out fires we were adopting a wrong system.

This seems to be the first time that the validity of fire-protection was ever called into question, and there can be little doubt that the theory originated in India and not in Burma.

EVIDENCE IN FAVOUR OF FIRE-PROTECTION.

It may seem superfluous to produce evidence in support of fire-protection, but as its validity has been impeached, it is advisable to show that there are competent foresters who vouch for its beneficial results basing their opinion on facts within their knowledge.

The first witness is Mr. B. Ribbentrop, C.I.E., formerly Inspector-General of Forests. That officer wrote § :—"These, in

* Indian Forester, Vol. XX, p. 285, "Failure of natural reproduction in the Teak Forests of the Coimbatore District."

† l. c. Vol. IX, p. 134, "A note from Coorg about forest fires," by 'Coorg.' This can only have been the late Mr. F. B. Dickinson who was then in charge of the Coorg Forests.

‡ l. c. Vol. IX, p. 359, "Grazing rights in Forests."

§ "Forestry in British India," p. 149 *et seq.*, 1900.

certain provinces almost general, conflagrations are the chief reason of the barren character of so many of our Indian hill ranges....... Their influence is more hurtful in proportion to the dryness of the region in which they occur.......After a fire has swept a few times over the forest, the compactness of its canopy gets destroyed and each successive fire leaves it more open. This being the case, the danger is reduced to a ground fire, which cannot touch the crown of the trees, between which the interspersed dead trees glow year after year like a torch till they are gradually consumed, doing but little and constantly less harm to their wider and wider disconnected neighbours. As time goes on, the process of destruction becomes thus slower and slower, but the end is none the less certain.... ..My parting advice is to extend fire-protection wherever feasible."

Concrete cases are quoted in support by the author for which the reader is referred to the book itself.

From the pen of the same author we have the following * :—

"The first consequences of these constantly recurring fires are bamboo forests with standard trees in the hills and *Kaing* grass savannahs in the plains. The cover of dead leaves on the ground is annually consumed ; humus, if it was in existence at some former period, has disappeared and cannot form under existing circumstances. The rain-storing power of the forest is lost and the bare friable soil is washed down into the streams......This erosion does not take place in areas which have been successfully fire-protected for some years and the streams in fire-protected forests become more and more perennial."

In his article previously referred to, Mr. D'Arcy showed that he did not subscribe to Captain Forsyth's views, for he wrote † :—

"Since this was written hundreds of thousands of acres of teak forests have been annually protected in the Melghat with indisputably a good effect to the forests, and the villagers themselves, the wild Gonds and Kukurs, recognize the wisdom of fire-protection."

* Forest Progress Report for British Burma for 1881-82.

† Indian Forester, Vol. IX, p. 359.

Similarly, Mr. Porter added to the passage already quoted *: " I refer only to these particular forests, or to others which may be similarly constituted and situated. The majority of the Madras forests have derived enormous benefit from fire-protection."

Writing of Sal forest in Oudh, Mr. A. F. Broun declared † that it " shows great improvement under protection as proved by enumeration."

Mr. Nisbet stated ‡:—" The south-east portion of the Chaungzauk Working Circle has been successfully protected against fire for the last sixteen years, and the effects are very apparent in the strong contrast between the fire-protected forests and those outside, *which are already, so early as the 5th January, either leafless or* are fast shedding their dry yellow foliage, whilst the teak trees in the reserve are still in full leaf of a healthy green colour. The prolongation of the active season of vegetation must considerably influence the annual increment on the boles of the teak trees "......

" There can be no doubt that fire-protection, even at its present high cost, is a profitable investment, especially in the dry forests which are far more extensive than those of a moist type."

In 1898, the Inspector-General of Forests, quoting Mr. Hearle, stated § in regard to Chir forests:—" In all the successfully fire-protected blocks round Ranikhet there were, in 1881, 374,836 Chir poles of from 6 inches to 1½ feet in girth, but in 1898 the number was found to be 573,612, which is equivalent to an increase of 53 per cent in less than twenty years, and this in spite of the enormous number of Chir poles granted away yearly to the right-holders. The efficacy of fire-protection should therefore be quite outside the pale of discussion, as it is indeed with everyone who has studied the question seriously."

Mr. E. M. Hodgson, Deputy Conservator of Forests in the Bombay Presidency, writes ‖ concerning the protection of " large areas of mixed teak forest which, until comparatively recently, had

* Indian Forester, Vol. XX, p. 285.

† l. c. Vol. XIII, p. 565.

‡ Forest Administration Report for Burma for 1894-95.

§ Review of the Forest Administration in British India for 1897-98.

‖ Indian Forester, Vol. XXXVI, p. 525, " Fire Conservancy in Indian Forests."

been burnt **every** year. The result is almost invariably an incomplete canopy, unsound trees, few or no seedlings and those that do occur unsound. The various grasses and reeds grow very tall and coarse in a forest of this nature subject to annual firing, thus adding to the difficulty of regeneration from seed and to the injury resulting from fires.

When the fires cease, apart from the obvious advantages to the existing tree-growth, the grass gradually gets less rank, and as soon as the tangled mass has rotted numerous teak, *Dalbergia latifolia*, etc., spring up in vast numbers and develop under fire-protection into sound, not unsound, trees."

The views of the present writer are emphatically in favour of fire-protection. He has not seen any forest in India where fire-protection is not advantageous, all factors considered. Even in the teak areas of Coimbatore referred to by Mr. Porter, he has found that fire-protection has assisted reproduction in the long run, as the sequel will show.

In open grass areas with little or no tree-growth, fires are also harmful in the matter of erosion and deterioration of the soil. Protection in such localities induces the re-appearance, sooner or later, of arboreous vegetation, wherever there is sufficient depth of soil. These remarks should be restricted to the Madras Presidency, the writer having a very limited experience beyond its boundaries.

EVIDENCE OPPOSED TO FIRE-PROTECTION.

We have already seen that Captain Forsyth considered that "by keeping out fires we are adopting a wrong system," that Mr. Dickinson thought that "in heavy teak forest fire does more good than harm," and that Mr. Porter believed that "fire-protection has done no good in the way of natural reproduction" owing to the encouragement of smothering weeds.

S. E. W. (presumably Mr.—now Sir—St. Hill Eardley-Wilmot) wrote in 1890 from the Central Circle, North-Western Provinces * :—"It has been observed that continued successful protection

* Indian Forester, Vol. XVI, p. 152, "On the Treatment of Bamboo Forests."

so favours tree-growth that after some years the bamboos die for want of light."

We now come to the more recent expressions of opinion, and as it is more particularly these that have led to controversy and contradiction, they must be quoted at some length and the several arguments will be serially numbered for convenience in subsequent reference :—

I. Mr. Slade in 1896 wrote * that though young teak seedlings suffer considerably from fire on the trees of that species, owing to their "protecting outside layer of corky bark, the fire has absolutely no effect."

II. That "all other vegetation (with possibly one or two exceptions, though I can recall none) suffers very much more severely in its younger stages than the teak, and consequently the annual fire cannot be considered otherwise than as an agent favouring the growth of teak at the expense of all (or almost all) other species."

III. He questioned whether humus is necessary or even desirable for teak, but admitted that repeated burning of seedlings is responsible for a great deal of the hollow timber found.

This article caused the appearance of others in the pages of the *Indian Forester* in support of the theory, notably one by Mr. F. J. Branthwaite, who wrote† :—"Want of light is a worse enemy to a young teak seedling than ordinary jungle fire . . . . in those areas which have been fire-protected for the longest time, and that most successfully, not once have I found humus ; earthworms, white-ants, etc., seem to eat up all the leaves and work them into the soil" and "where the canopy is very light owing to the jungle being yearly burnt over, the natural regeneration is better than in the fire-traced areas."

In 1902, Mr. H. C. Walker re-opened the controversy‡ and since then has repeatedly written in the same strain, and it is

* Indian Forester, Vol. XXII, p. 172, "Too much fire-protection in Burma."

† l. c. Vol. XXII, p 257 and 302.

‡ l. c. Vol. XXVIII, p. 293, "Fire-protection in Teak Forests in Lower Burma.

principally his statements and deductions that are to be scrutinised. He asserted :—

IV. "When the seed falls on a thick layer of dead leaves such as accumulate in fire-protected forests, the conditions are very unfavourable to germination and very little natural regeneration is found.

... as fallen trees and bamboos and decaying vegetable matter decompose very slowly .... the accumulated amount is very great."

V. ".... when the leaves are burnt, I think I am correct in saying that only the nitrogenous compounds are lost and that the essential salts are left. Now in a teak taungya plantation seedlings grow most strongly in places where a log has burnt to ashes, in spite of the fact that in such places the loss of nitrogenous matter is greatest and, therefore, this loss cannot be important."

VI. "To a small extent, I think, in protected forests decomposition of leaves takes place by their becoming so dry during the hot weather that they crumble into dust and this process is similar to decomposition by fire."

VII.* "... the leaves which fall annually do not accumulate and form humus in a fire-protected area, but when not destroyed by fire are eaten by termites .... when destroyed by fire there is no loss of mineral matter."

VIII. "Old age, suppression, etc., appear to me to sufficiently account for the hollow trees we find, and I entirely fail to understand how the burning back of a teak seedling can possibly cause hollowness."

IX.† ".... one of the oldest protected areas in Burma, and from the commencement, some forty years, has been successfully protected. Yet, in spite of improvement

* Indian Forester, Vol. XXIX, p. 554, "Fire-protection in the Teak Forests of Lower Burma."

† l. c. Vol. XXX, p. 366, "Fire-protection in the Teak Forests of Lower Burma."

fellings, hardly a teak seedling is to be found although in adjoining unprotected areas natural *regeneration of teak is very good.*"

X.* "There is little doubt that these forests have been burnt over annually for untold periods of time, and, as in spite of this, growth is most luxuriant .... I think the idea of *impoverishment of the soil* may be dismissed as a myth."

XI. "But in Burma earthworms are comparatively scarce."

XII. "I have seen large quantities of dead leaves being devoured by termites and have endeavoured to discover what becomes of the material. It seems that every morsel consumed passes through the bodies of several termites by a process termed lactation, but I cannot discover definitely whether much is returned to the soil. Possibly some of the residue is concentrated in their mounds or nests, more probably both in the case of termites and beetles, the leaves consumed are utilised to build up their structure and then that of insectivorous birds, and then that of other birds and beasts of prey, so that a long time elapses before any matter is returned to the soil."

XIII. "When leaves are burnt only the ash remains, which, however, contains the essential salts."

XIV. "In unprotected areas the leaves are burnt and disappear in March. In protected areas they disappear during the rains. The disappearance is so rapid in both cases, that I should think the probabilities are that there is little difference in the fertility of the soil one way or the other. . . ."

XV. Mr. Walker further contends that middle-aged trees are sound and in any case injury by fire is very slight.

XVI† ". . . . it is practically certain that our deciduous forests have been annually burnt over, not merely for the

* l. c. Vol. XXXIV, p. 339, "Fire-protection in Burma."

† Indian Forester, Vol. XXXVI, p. 356, "Fire Conservancy in Indian Forests.

last century or so but for hundreds of thousands of years."

XVII ". . . . as the result of experiments at Rothampstead, it has been discovered that when soil is heated, the amount of nitrogen is increased . . . . the nitrogen-fixing bacteria . . are less affected by the heat than the phagocytes."

XVIII* . . . . Criticising a note by Mr. H. A. Latham, Mr. Walker doubts that the minerals in leaf ash are lost to the soil through washing of the ashes down slopes into the streams and through the agency of wind.

XIX. He further denies that floods materially decrease in areas protected from fire or that streams issuing from them are more limpid or that erosion is greater in unprotected forests.

Mr. Ribbentrop described† a class of forest in Burma "in which the valuable species are found with an under-growth of evergreen dense, periodically and gregariously-flowering bamboos, which more or less prevent the natural reproduction of tree-growth at any other time except whilst the bamboo is seeding." In such forests he admitted that "the use of properly-controlled fires in selected areas is indicated when the bamboo flowers."

Referring to vestiges of teak found lingering on in the midst of evergreen forest, the late Sir Dietrich Brandis wrote‡:—" When teak first sprang up here, perhaps two centuries ago, the forest must have been altogether of a different character. The cessation of jungle fires for a few years, either caused by rainfall during the dry season, or because there were no travellers or others to set fire to the jungles, may have permitted the accumulation of vegetable mould and favoured the springing up of a new class of trees among the teak. Let these trees of the dense evergreen forest once take possession of the ground, so as to keep off jungle fires, and the progress of their growth is irresistible . . . The

* l. c. Vol. XXXVI, p. 679, " Fire Conservancy in Indian Forests."

† Forest Administration in Burma in 1895-96.

‡ Indian Forester, Vol. XXIX, p. 187, " Teak in Evergreen Forest."

springing up of teak seedlings in the dense shade is out of the question, and the teak dies of old age without any chance of propagation."

Mr. H. Carter* supports Mr. Walker in some of his contentions and adds :—"On sound fairly large trees I don't think fire has any effect at all until they begin to lose vitality, or unless an exceptional amount of débris is collected round them . . . . The effect of a thick layer of leaves such as is found in a fire-protected forest in preventing the radicle reaching the ground is known to every Forest Officer."

Mr. R. S. Troup published† some figures of enumerations in Tharrawaddy, showing a much larger number of seedlings and young poles in burnt areas than in the protected ones. Moreover, there were fewer unsound and suppressed trees. The dead trees appeared to have come by their end through suppression and not by fire. He added :—"It is impossible . . . to give any idea of the terrible destruction which is being wrought in our once valuable moist mixed forests by prolonged fire-protection."

Mr. Bruce gave an interesting account‡ of reproduction of teak in forests worked intensively for bamboos :—

"Both inside and outside fire-protected areas the effect is the same, but outside the germination is better."

". . . . once away from the areas attacked by bamboo cutters and inside the fire-protected area, the bamboo is found covering the ground with magnificent clumps, while careful and prolonged search will not enable one to discover one teak seedling which has germinated in the last nine years, *i.e.*, since fire-protection was started, while the old teak stools even are being killed off by the dense shade of the bamboos combined with that of other trees."

In 1907, Mr. F. Beadon-Bryant, then Chief Conservator in Burma, quoted figures of countings in Tharrawaddy§ which revealed a considerable shortage of teak saplings under one foot

* Indian Forester, Vol. XXX, p. 363, "Fire-protection in the Teak Forests of Burma".

† l. c. Vol. XXXI, p. 138, "Fire-protection in the Teak Forests of Burma.

‡ l. c. Vol. XXXII, p. 390, "The Reproduction of Teak."

§ l. c. Vol. XXXIII, p. 537, "Fire Conservancy in Burma."

in diameter in fire-protected compartments. He then expressed the opinion that "Prolonged fire-protection results in a marked decrease of trees of the younger classes." . . . those which spring up after fire-protection "for the most part either damp off or are suppressed by the heavy cover of bamboos which benefit enormously from fire-protection and which are driving out practically everything before them . . . . What is taking place in Tharrawaddy is taking place in all moist forests under fire-protection in Burma, *i.e.*, the teak is being gradually and surely killed out. In forests annually burnt over, on the other hand, the cover remains considerably lighter than where protection is in force and the young teak resisting the effects of fire better than its companions is able to and does establish itself."

With one exception in favour of bamboos, all the facts and arguments hitherto quoted refer to teak. We find, however, that the same effect as the result of the same cause has been claimed in the case of two other species: Sal (*Shorea robusta*) and Chir (*Pinus longifolia*).

The late Mr. C. C. Hatt seems to have been the first to have pointed this out in connection with Sal in 1905.* His asseveration found an echo in the Forest Administration Report for British India for 1904-05, where we read :—" In the damper forests, however, whilst fire-protection has in some cases caused the establishment of well-stocked forests of the desired species, it has also encouraged the growth of many worthless trees, and it will be necessary to adopt measures to assist the sal against these undesirable competitors . . . ."

Similar evidence has been furnished by Mr. E. M. Coventry,† Mr. A. L. McIntire,‡ Ranger Sukh Lal Dat§ and Ranger Sen Gupta.‖

* Indian Forester, Vol. XXXI, p. 568, "Mixed Sal Forests and Fire-protection."

† l. c. Vol. XXXIII, p. 174, "Notes on Sal Reproduction."

‡ l. c. Vol. XXXIII, p. 312, "The Reproduction of Sal from seed."

§ l. c. Vol. XXXIII, p. 456, "Fire-protection and Natural Regeneration" and Vol. XXXV, p. 154, "Light burning and Natural Reproduction of Sal."

‖ l. c. Vol. XXXIII, p. 549, "Reproduction of Sal from seed in the Jalpaiguri Division."

It is interesting to find that these views are supported by an American Forester who visited the Sal forests of Assam—Mr Barrington Moore, M. F.—who wrote*: "...the under-growth comes up very much weakened or not at all after a fire, whereas the Sal comes up as vigorously as ever . . . Obviously the only alternative (to costly thinnings) is to burn this under-growth . . . Any one who considers the use of fire as a breach of all the laws of sylviculture *need only see the excellent condition of a forest continuously* burnt and then protected for one year."

As regards Chir, Mr. E. A. Smythies† gives some facts observed in the neighbourhood of Ranikhet, and claims that there is "in absolutely unprotected open forests, regularly burnt every year, regeneration as fine as anything we can show in the scientifically managed, fire-protected, closed-to-grazing areas" and that as a result of protection "we have been obliged to resort to artificial sowing in our regeneration coupes."

DISCUSSION AND CRITICISM OF THE EVIDENCE.

When the evidence is concerned with generalitis, such as the value of humus, of nitrogen, etc., the question is comparatively simple; but when one turns to points of fact: the presence or absence of seedlings and of humus, the occurrence of erosion, etc., the enquirer unacquainted with the locality is at an obvious disadvantage. In such circumstances one must depend upon the writings of those in a better position to judge. On referring to these reports, however, one is faced by a bewildering situation *very far removed from unanimity*; it is precisely this predicament that dictated the compiling of this paper.

In order to make the nature of these puzzling contradictions clear, a few conflicting statements are pilloried below:—

Extract from the Burma Forest Administration Report for 1896-97.

By Mr. G. R. Long, West Salween.	By Mr. H. B. Anthony.
"That outside fire-protected areas the *natural regeneration*	"In many parts of the fire *protected* Meple-T h a u n g y *in*

* l. c. Vol. XXXV, p. 213, "Notes on the Forests of Northern India and Burma."

† l. c. Vol. XXXVII, p. 54, "Fire-protection in Chir Forests."

of teak seems more frequent than within areas protected from fire. In the Sinswe Reserve fire-protection is the immediate cause of a dense undergrowth through which teak seedlings unassisted by cultural operations can never be expected to force their way."

Tharawaddy Division.

"In non-fire-traced forests the reproduction of teak is good, but inside fire-traces, it is decidedly scanty."

Reserves when the upper canopy is not too dense and where bamboos have not obtained a footing, the natural reproduction of teak is plentiful and good, but in the other reserves and open forests it is much poorer, the amount of reproduction being in exact proportion to the amount of protection afforded to the forest.

In the Thaungyin Ranges, where the villages are few in number, the forests suffer but little from the inroads of men and cattle, and not infrequently tracts of greater or less extent accidentally escape the annual conflagrations.

In these forests, therefore, it is not unusual to find teak seedlings and poles here and there, but in the open forests of the Hlaingwe Range, which are greatly resorted to by men and cattle and through which fire sweeps with unfailing regularity every year, natural reproduction of teak is absolutely at a stand-still."

Extracts from the Burma Forest Administration Report for 1909-10.

Yaw Division.

"... after a patch of cultivation has been abandoned by the Chins, dense crops of teak seedlings appear. These, however, are soon overtaken in height by a dense growth of grass and disappear in the fierce fires that sweep the *Ponzo*."

Toungoo Division.

"On the more shady slopes and in the valleys, the young teak is killed out by rank grasses, etc., which flourish with the help of fire-protection."

Could anything be more disconcerting!

We may now see whether there is agreement on the several points which have been serially numbered above, and consider whether there is reason to disagree with the deductions.

I.—Immunity of teak trees from fire.

F. B. D. commenting on Mr. Slade's article wrote* :—" Teak trees are, as a matter of fact, often badly injured by jungle fires .... Sometimes the tree is killed outright."

Another opinion runs† :—" I have just passed through a promising young timber forest of teak ... and other species, where practically every stem of this immature crop is seriously injured by *leaf fires*, which have hardly even blackened the trunks, and thus the well-being of the standing stock and the future of the forest as a whole has been seriously endangered."

In 1901 Mr. H. J. Porter reported‡ :—" The tree which suffers most from fire is the teak on account of the oil it contains, there are not a great number of this species, but it is doubtful if there is a sound one in the whole range."

Mr. A. Rodger published figures § showing that " 8 per cent of the standing stock of marketable teak trees have been so much damaged by fire that they have lost a considerable part of their commercial value, and further that 52 per cent have been so damaged as to impair their vitality and lead the way to greater damage later on."

Further enumerations communicated ‖ by the same officer showed only 7 per cent trees undamaged by fire out of 1,103 counted; out of 93 per cent damaged 81 per cent had lost part of their commercial value.

Finally, the late Sir Dietrich Brandis reported¶ :—" Trees, however, that are not perfectly sound, for instance, that have some

* Indian Forester, Vol XXII, p. 258, " Too much Fire-protection in Burma."

† l. c. Vol. XXVII, p. 124, " On Leaf Fires," by O. C.

‡ Working-Plan Report for the Cumbum Range, Madura District.

§ Indian Forester, Vol. XXX, p. 372, " Fire-protection in the Teak Forests of Burma."

‖ l. c. Vol. XXXIII, p. 17, " The Effects of Fire in Teak Forests."

¶ Report on the Teak Forests of Pegu for 1856.

dry branches on them, or where the bark near the ground has fissures, which is not unfrequently the case with teak—such trees suffer serious damage from these jungle fires, and not seldom become hollow, or otherwise injured."

"Greater still is the damage done to seasoned trees and logs by these fires. For these are either destroyed or so much injured that they lose considerably in value . . . ."

II.—Greater immunity of teak over other species.

In the article already quoted, F. B. D. stated his opinion that other species spring up more rapidly if anything than teak.

See also the quotation above from Mr. Porter.

As will be seen later, the writer of this note has observed that in the Anamalai forests of South Coimbatore (the very ones in which Mr. Porter lamented the absence of teak regeneration), teak showed signs of more frequent and greater damage from fire than any other species associated with it.

In this connection Mr. J. W. Oliver states* :—"It must be admitted that teak does withstand fire better than many other trees, but there seems no reason to suppose that this is the result of adaptation, for other trees have been exposed to precisely the same influences and have not developed means of resisting the effects of fire."

Moreover, if fire is to be "considered . . . as an agent favouring teak at the expense of all (or almost all) other species," and if the teak forests have been "burnt over . . . for hundreds of thousands of years" (points X and XVI) it is pertinent to enquire why we do not find large areas of pure (or almost pure) teak forest.

III.—Necessity of humus for teak.

This point was dealt with by Mr. J. W. Oliver,* who wrote: ". . . the theory . . . that the teak tree prefers a soil devoid of humus is opposed to the fact that the best teak is generally found on well-drained, alluvial flats on the banks of streams where the soil is entirely composed of fine earth mixed with vegetable remains washed down from higher ground."

* Indian Forester, Vol. XXII, p. 259, "Too much Fire-protection in Burma."

IV.—Accumulated leaves hinder germination.

Mr. F. J. Branthwaite criticising some remarks by Mr. Slade wrote as follows on this very subject* :—"Fire-protection prevents the leaves, grass, etc., being burnt, and as they are not eaten and worked into the soil until after the first burst of the monsoon, the seeds find a lodging amongst these leaves, grasses, etc., and are retained and germinate even under a thick canopy of bamboos."

Then, teak seeds do not germinate at once, but during the rains, and as the leaves disappear rapidly through the destructive agency of insects, etc., once the rains set in, it is difficult to grasp why the radicle of the germinating seed is prevented from reaching the soil.† For the rapid disappearance of the leaves as soon as the rains set in, we have the evidence of Mr. Walker himself, *vide* points VII and XIV.

V.—Loss of nitrogenous compounds unimportant.

The instance chosen by Mr. Walker to support this point is not convincing. No one claims that an ordinary fire dissipates the nitrogen stored in the soil, but only that contained in the matter burnt. The reason for the stronger growth of the seedlings at the place where a log has burnt to ashes is that they have benefited by the extra quantity of other plant-food supplied by the ashes, there being a sufficiency of nitrogen in the soil. The nitrogen in the log, however, has been lost.

VI.—Pulverised leaves compared with leaf-ash.

Mr. Walker might as well contend that the ashes of tea leaves are equivalent to tea-leaf dust.

VII.—See reply to XIV.

VIII.—See reply to XV.

IX.—Absence of teak seedlings in fire-protected forests.

That there is some diversity of opinion on this subject the "pillory" will have shown. Moreover, it is fairly certain that

* l. c. Vol. XXII, p. 302, "Too much Fire-protection in Burma."

† Indian Forester, Vol. XXX, p. 363, "Fire-protection in the Teak Forests of Burma."

immediate good results cannot be expected invariably on the initiation of fire protection and the closing sentence of the following extract permits one to question whether the forest referred to had been *successfully* protected for forty years. "* . . . is it not the case that everywhere the first effects of fire-conservancy are inimical to natural reproduction. Does it not favour the rapid growth of grass, shrubs and soft-wooded species more than that of the principal species? When, however, the fire-protection is continuously successful for a sufficient length of time the conditions are altered. Does not then the rank growth of grass die down, and is it not then replaced by other finer sorts which afford no obstruction to the germination of the seeds, while the shrubby growth serves as protection to the young seedlings?"

"If this is so, then what is wanted is continuous *successful* protection. I have just been reading the last Burma Forest Report, and have been much struck by the marked absence, year after year, of continuous success in fire-protection."

The following from the pen of Sir D. Brandis † does not entirely support the contention: ". . . Teak forests, therefore, in a jungle of this bamboo (Wapzoogelay) are much exposed to severe injury from fires. The number of seedlings is consequently diminished...."

The forests are then classified and remarked on:—

"*First Group, alluvial.*—Jungle fires not regular and not very dangerous. Seedlings abundant . . .

Second Group.—Jungle fires regular and destructive. Seedlings less numerous than in first group.

Third Group.—Bamboos mostly deciduous. Jungle fires regular and not very destructive. Seedlings numerous, but generally burnt down to the ground once or twice before they make a start strong enough to enable them to resist the effects of the fire"

It must be conceded, however, that there is a good deal of evidence to show that in some localities at least, the protection

* l. c. Vol. XXX, p. 305, "On certain important Forest questions," by "Non-Burman."

† Report on the Attaran Forests for 1860, p. 51.

from fire afforded so far has not resulted in satisfactory natural regeneration of teak when not assisted by other operations, and that seedlings are more abundant in adjoining similar areas burnt over annually.

It does not follow that this state of things is permanent and it may alter with continued treatment, as indicated by Mr. Clutterbuck. *

"It would appear that where reproduction is still wanting in areas which are protected from fire, it is because the areas have not been protected for a sufficient length of time."

"Recently we saw an area of Sal forest which had been protected from fire for nearly thirty years in which natural reproduction has established itself only during the past three years. If the area had been inspected four years ago, it would have appeared that protection from fire for some twenty-six years had been a failure as far as regeneration was concerned."

"After an area has been subject to fires for a great number of years, the soil often gets into a very bad state and it may take many years of protection to bring it into a suitable condition to form a seed-bed for the principal species."

The above remarks seem pregnant with significance. It seems probable, too, that the longer an area has been subjected to fire so much the longer will be the period required for the restoration of normal conditions. The length of the period of recuperation will be determined by general conditions and the special local circumstances of the species involved.

X.—See reply to XVI.

XI.—Dearth of earthworms in Burma.

As we shall presently see, both Mr. Ribbentrop and Mr. Nisbet have referred to the "myriads" and "countless millions of earthworms, ants, beetles, etc.," in Burmese forests. It is not very material, however, whether it is by earthworms or other creatures that the débris are consumed, but is not the absence of earthworms reported by Mr. Walker an effect of annual fires

* Indian Forester, Vol. XXXV, p. 154, Editorial comment on "Light burning and Natural Reproduction of Sal."

and a sign of deterioration? M. Jacquot * points out that one of the results of fire is the migration of earthworms, and insists on the harm to the forest through this evacuation.

XII. }
XIII. } *See next section.*

XIV, VII, XII and XIII can be taken together with this point, as all contend that *all essential plant foods remain in the ash of burnt leaves and that there is no practical difference whether the leaves are burnt or decomposed by animals and decay.*

Now here only one of two things can be meant: either that nitrogen is not an essential plant-food, or that it remains in the ash. Both conceptions are false.

Mr. E. Henry wrote in the *Revue des Eaux et Forêts*† :—"Forest trees are little behind agricultural crops in their demand for nitrogen . . . Five to eight per cent of beech wood is nitrogen and the leaves a little more." And again ‡—"In forests where the soil covering is preserved the proportion of nitrogen goes on increasing; on the other hand, removal of litter reduces it rapidly. If repeated, the vegetation languishes for want of nitrogen."

Much more in the same strain could be adduced, but it will suffice to refer enquirers to the text-books and to point out that even for such woody crops as coffee nitrogen is the principal ingredient of the manures used, except when the intention is merely to remedy a deficiency of one of the other plant-foods.

Turning to the loss of nitrogen through burning, this loss is in exact proportion to the completeness of the consumption by fire. Thoroughly burnt ashes do not contain even traces of nitrogen, the whole of which is volatilised and given off into the air, where it is available to a few species of trees only. The ash contains other elements of plant-food and, therefore, is a valuable fertiliser.

When leaves and débris are allowed to decay gradually and even when rapidly devoured by insects, etc., the nitrogen is not set

* "Incendies en Forêt" by A. Jacquot, translation, p. 215.

† ndian Forester, Vol. XXIII, p. 439. "Nitrogen and Forest Crops." Translation by F. Gleadow.

‡ Incendies en Forêt," by A. Jacquot, translation, p. 197.

free, or at any rate but a small proportion is lost. *It is not the* nitrogen that builds up the frame of the leaf-eating creatures, but mainly the carbo-hydrates, the nitrogen being ejected in the *fæces*, which are notoriously rich in that element. The greater portion of the nitrogen in the leaves, etc., therefore, is returned to the soil when the soil-covering] is eaten, and that probably very rapidly.

The argument that the nitrogen is transferred to the frames of insectivorous insects and birds, and then to that of birds and beasts of prey, is somewhat ingenuous and would have weight only if we assume a series of insectivorous and carnivorous animals waiting each to snap up the next smaller before it has had time to digest its meal, in perpetuity. In practice the substance must sooner or later return to the soil either in the form of *fæces* or the dead body *of the ultimate recipient—the return of the nitrogen to the soil is* merely deferred.

We also find it claimed that no humus is formed and that there is no practical difference whether the leaves are eaten or burnt. The subjoined extracts do not support this proposition :

*" In humus produced above the water-line, all trace of vegetable structure is destroyed by the leaves being gnawed and passed through the bodies of earthworms, caterpillars, wire-worms, etc. . . . Experiments with dead leaves pulverised by the action of these animals, in comparison with the same leaves not attacked by them show that little or no influence on the rate of decay results from their action. After passing through their bodies, the organic matter is still fit to nourish moulds and bacteria, and when these have been multiplied sufficiently to accumulate a fresh stock of *protoplasm, the earthworms, etc., attack it again,* and so destroy all trace of structure."

†" In swallowing portions of humus and assimilating their nutritive principles, worms reduce the earth to a sort of paste and so contribute to the improvement of the soil . . . '

* Indian Forester, Vol. XVII, p. 330. "The Formation and Properties of Humus."

† Indian Forester, Vol. XXI, p. 370 "Forest Soil." Translated from the *Revue des Eaux et Forêts*, by A. F. G. (Gradon.)

Mr. Nisbet as Conservator of Forests, Pegu, reported as follows* :—" To counteract this (washing away of the soil) and to produce good surface soil as speedily as possible, nature appears to have made the wonderful provision that countless millions of earthworms, ants, beetles, etc., should have the power of consuming such forest débris as fallen stems, dead wood, leaves, etc., and, after extracting their requisite nourishment from it, of emitting the *fæces* not in the form of a more or less altered organic matter, but as a very fine pure and fertile loam. Throughout the whole year some or other of these myriads of animals are at work converting the débris into good soil to replace what has been or is being washed away by the heavy rainfall, but the greatest activity seems to be at the termination of the rains and at the commencement of the wet season. . . ."

"It has also been shown that the dead leaves, although they do not form humus are when protected from fire rapidly restored to the soil in a form in which they can be easily assimilated by plants."

Next, the Inspector-General of Forests (Mr. Ribbentrop) remarks in his review of the Forest Administration of Burma for 1895-96 :—" However, there can be no doubt that in fire-protected forests the leaves and other decaying vegetable substances are returned to the earth and the chemical properties of humus are imparted to the surface soil, which is, moreover, loosened by the action of myriads of earthworms, ants, beetles, etc."

" It seems to me immaterial whether the manuring principles are brought back to the soil by decomposition, or through the *fæces* and decomposing bodies of worms and insects, like stable-manure ploughed under in fields."

Another Inspector-General of Forests has said† :—" In the Tharrawaddy forests first protected, there is now a perfect forest soil, soft under foot, and although true humus formed from decaying leaves may not be present, the soil must retain the same nut itive properties as would true humus."

* Forest Administration Report for Burma for 1894-95.

† Indian Forester, Vol. XXXIII, p. 537, "Fire Conservancy in Burma," by F. Beadon-Bryant, 1907.

Finally, we find the following words in one of the best works on soils* :—" The key to maintaining the fertility of the soil is to have plants decaying in it all the time."

XV (also point VIII).—*Middle-aged trees claimed to be sound and unsoundness ascribed to suppression and old age.*

It has already been shown that there are dissentients to this proposition. A few more opinions may be useful, however.

An anonymous contributor to the *Indian Forester* declared† " . . . hollow trees are not necessarily by any means always old trees . . . many, nay most, full grown teak trees are hollow, sometimes for several feet up the butt . . . damage to the growth of the tree is caused by the scorching of the bark which interferes with the rising of the sap; and it is to this cause that in the majority of cases the injury is due in the growth of the tree, which Mr. Walker attributes to suppression by shade."

Thus Mr. Beadon-Bryant‡ :"—There can be no doubt that much of the unsound teak to be found in all our forests is due to the action of fires, which cut back the young trees year by year until they can send up a shoot strong enough to resist fire. The damage thus sustained in its earliest years undoubtedly causes many a tree to become unsound, and as the unsoundness develops, the annual fires do more and more damage to the tree."

Mr. (now Sir) S. Eardley Wilmott supports this opinion.§ " The effects of fire on established teak trees, young and old, was not disputed, even leaf fires of small intensity produced injuries in the base of the stems that soon caused dry-rot and other unsoundness in the heart of the timber."

Finally, Mr. H. Carter, while assenting to some of Mr. Walker's other points, testified ‖ :—"The loss of young seedlings by fire is undoubted, and although despite fires seedlings grow up it is at the

* " Soils, " by S. W. Fletcher.

† Indian Forester, Vol. XXX, p. 156. " Fire-protection in the Teak Forests of Lower Burma," by " An Old Protectionist."

‡ Indian Frester, Vol. XXXIII, p. 537.

§ " Forest Life and Sport in India," p. 194 ; published 1911.

‖ Indian Forester, Vol. XXX, p. 363, " Fire-protection in the Teak Forests of Burma."

oss of several years' growth, estimated at ten, and at the cost in many cases of scars near the ground."

See also Mr. Slade's admission in point III.

XVI (together with X).—*The great antiquity of forest fires postulated.*

This assumption is altogether gratuitous. There can be no doubt that forest fires have increased with the multiplication and spread of man. Practically speaking, all fires originate, directly or indirectly, through the agency of man. In the dim past when men were few, and even now in uninhabited tracts, the forests escaped and do escape.

It will have been noticed in some of the extracts quoted that the authors associate the recurrence of fires with the proximity of men and their herds. For instance, Sir D. Brandis wrote: "The cessation of jungle fires . . . either caused by rainfall or because there were no travellers to set fire . . ."

In North America forest fires were formerly neither as frequent nor as widespread as in the present times, in spite of increased care and improved measures of control. The *Journal of Forestry* declares* that forest fires are much more frequent now than in the past.

XVII.—Nitrogen in the soil increased by heating.

The increase here referred to is due to the phagocytes inimical to the nitrogen-fixing bacteria being more sensitive to heat than the latter, consequently these are freed from their enemies for a period after the temperature has been raised sufficiently to kill the phagocytes without injuring the *Azotobacters* and their allies.

No doubt something similar happens in the surface layers in the case of a forest fire, but in the layers burnt the nitrogen-fixing bacteria themselves are destroyed, and this damage far outweighs the very small benefit in the layers immediately below.

But even this neglects to take into account the far more important loss through the destruction of the nitrifying bacteria

* Quoted in the Indian Forester, Vol. IX, p. 308, "Fire Conservancy from the 'Journal of Forestry.'"

present in the fallen leaves and débris. This loss is by no means negligible, as we are informed by M. E. Henry* :—"I think there is, however, a more important and general compensating cause, hitherto ignored, namely, the fixation of nitrogen from the air by dead leaves," and that author goes on to state that dead leaves *take up from half to three-fourth per cent. of their weight of* nitrogen from the air.

M. Détrie may also be quoted† :—"The removal or mere moving of the layer of dead leaves, not only interferes with the formation of vegetable mould, but actually diminishes the fixation of nitrogen in the soil by stopping the development of micro-organisms."

So that by burning the soil-covering not only is the forest deprived of the nitrogen in the layer destroyed—amounting according to Henry, to from five to eight per cent of its weight—but also of the nitrogen that would have been obtained from the air by the agency of the micro-organisms destroyed with it.

Further, it must be remembered, that the floor of the forest, especially in the tropics, is generally covered with a growth of suffrutescent plants and shrubs, some of which (usually *Leguminoseæ*) are capable of fixing free nitrogen from the air. These plants, together with their nitrogen, are destroyed.

The crux of the question is whether nitrogen is an essential element of plant-food. This has already been dealt with in the answer to point XIV; the conclusions‡ of an eminent observer—Dr. A. Schwappach—the results of experiments extending over several years may be recorded as additional proof:—"These figures would seem to show conclusively that the removal of dead leaves is more harmful on poor soils than on fertile ones, that on the former the practice may diminish the production of wood by more than one-half. Also, that the influence of the removal of the leaves is greater the more frequently and the longer the practice is continued."

* Indian Forester, Vol. XXIII, p. 439, "Nitrogen and Forest Crops."

† Indian Forester, Vol. XXIV, p. 1, "The fixation of atmospheric nitrogen by dead leaves."

‡ l. c. Vol. XIX, p. 132. "Influence on the Vegetation of a Forest on the removal of Dead leaves from the soil."

This much admitted, it seems impossible to deny that annually recurring fires must diminish the quantity of nitrogen in the soil until, at the long last, the amount left is insufficient to support a forest crop.

XVIII.—Ash not carried off by wind or water.

As we have seen this statement was made in denial of a suggestion from Mr. H. A. Latham, but the latter gentleman is not the first to bring this loss to notice, as the next few paragraphs will show.

"* . . . the whole of the leaves and branches falling from the trees are consumed by the jungle fires, and the ashes instead of affording nourishment to the trees are washed away by the first rush of the rain."

"† . . . on dry steep hill-slopes . . . a few days after a fire has passed through the forest, the burnt localities present the appearance of having been carefully swept of all leaves, the ground being perfectly bare, and every trace of ashes being removed by the wind."

"‡ In the case of fires the wind dissipates the ashes and the rain washes them away, especially on hilly ground. Very little of what has been extracted from the soil by vegetation is returned to it."

Many similar assertions could be cited but one more will suffice:

"§ . . . the villagers . . . firing the hillsides in order that their fields below may be benefited by the ashes which are washed down by the rain." (This practice has come under the present writer's own notice in the Ganjam District.)

XIX.—Floods and erosion not greater in unprotected areas.

Such a statement cannot but create the impression that the author's experience in this direction has been extremely limited

* Report on the Attaran Forests for 1860, by D. Brandis.

† Working Plan of the Thonze Reserve, by J. W. Oliver.

‡ Forest Administration in Burma in 1895-96, by Mr. B. Ribbentrop, C.I.E.

§ Letter No. 74, dated 7th January 1910, from the Chief Secretary to the Government of Bengal to the Government of India.

Probably he would restrict the application of his remarks to Burma but as we will now see, other officers in Burma find their observations leading them to opposite views. Moreover, it is stated that fire-protection encourages a rank growth of grass and soft-wooded shrubs, so dense, indeed, as to choke teak seedlings. It must be clear, beyond the necessity of proof, that such a covering to the soil is bound to act as a check on surface wash and in its absence erosion actually does take place, as reported by Mr. J. W. Oliver *:—"The consequence (of fire) is that when the heavy monsoon rains set in, there is no covering to protect the soil and the soft shale of which these hills are composed is rapidly eroded. . . . ."

Besides the living soil-covering the soil has also been robbed by the fire of the protection afforded by *the layer of dead leaves*, etc. Even small stones lend their aid as pointed out by Mr. J. Nisbet †: "During the torrential rains of the south-west monsoon in Lower Burma, the softest top layer of the soil on the hillsides is washed away for a depth varying from 1 to 3 or 4 inches, save only where protected by a short soil covering or even by small stones often found topping stalagmite-like pinnacles of soil in the succeeding dry weather." If small stones can achieve this how much more can be expected of growing herbage and the large fallen teak leaves especially when sodden.

But there are other results of the burning of the soil covering which have not yet been taken into account : the loss of seeds and the drying up of the soil.

On sloping ground when the soil is bare, seeds are largely carried off into the water-courses and are lost to the forest, whereas where the leaves and débris remain many of the seeds are caught up and germinate *in situ*.

Further, though it is contended that the leaf fires merely have a stimulating effect on the thick-walled teak seeds without injuring them, that actually a large number are killed cannot be doubted in the face of recorded observations.

* Working Plan of the Thonze Reserve, by J. W. Oliver.

† Forest Administration Report for Burma for 1894-95—remarks by Mr. J. Nisbet, Conservator of Forests, Pegu Circle.

Sir D. Brandis wrote*— "Lastly, the jungle fires, in a great measure retard the increase and renovation of the teak forests, by destroying an immense quantity of teak seeds that cover the ground and might otherwise have germinated."

Similarly F. B. D. †:—"I have frequently cut open scorched teak seeds and found the kernel shrivelled up and useless."

As regards protection against dessication, Mr. Nisbet affirmed.‡:—"The soil is nevertheless to a considerable extent protected from evaporation during the hot weather by the dead leaves lying on its surface which remain undestroyed until the herbaceous growth, usually found during the rains . . . has sprung up."

Before leaving the subject of teak, attention may be drawn to the fact that Mr. Walker argues that even admitting that a certain amount of commercial depreciation is occasioned by fire, the gain secured by protection is incommensurate with the expenditure entailed. As Mr. Rodger has shown that this depreciation extends to 60 per cent of the crop, one is justified in enquiring whether Mr. Walker is prepared to rest content with a 40 per cent standard of soundness.

We can now refer briefly to the other three species that at one time or another have been claimed to be adversely affected by fire-protection.

BAMBOOS.

The reference to bamboos was by Mr. Eardley-Wilmot, the same gentleman wrote a year later §:—"Since writing on this subject I have had the opportunity of inspecting the bamboo forests of Bundelkhand, where the conditions of climate and soil vary considerably from those obtaining further north. . . . In result the bamboo of Bundelkhand . . . suffers much from forest fires, so that there fire-conservancy is evidently a necessity if we wish to preserve and improve the growth. In writing of fire-conservancy

* Report on the Teak Forests of Pegu for 1856.

† Indian Forester, Vol. XXII, p. 258, "Too much Fire-protection in Burma"

‡ Forest Administration Report for Burma for 1894-95.

§ Indian Forester, Vol. XVII, p. 184, "On the Treatment of Bamboos."

relatively to bamboo forests, it is, therefore, very evident that local details are all-important."

Shorea robusta.

With regard to this species the present writer can vouch from personal experience in Ganjam for its immediate response to fire-protection in the shape of a dense vigorous advance growth. The rainfall averages 50 inches; in the hot weather the forests become very dry. But even in damper forests fire-protection has benefited sal, as we have seen in the sentence quoted on page 201.

Pinus longifolia.

In reply to Mr. Smythies' article, Mr. M. R. K. Jerram wrote as follows* :—". . . there are instances in which annual fires undoubtedly do damage beyond injuring seedlings and young plants. . . . I have observed damage to trees of *all* ages by annual fires. The fire gets into the crowns and sweeps right through the clump klling many, occasionally all. In spite of fire having swept through the area in the previous year, the following season's fire does sometimes actually reach the crowns of poles thirty feet high and probably of poles even higher than this."

CONCLUSIONS.

It is hoped that the arguments on both sides have been fairly exposed in the foregoing pages, and we may now consider what general deductions may be made from this review.

Firstly, the want of unanimity in matters of fact is forced on one's notice; *secondly*, it is evident that conditions differ so greatly even in neighbouring localities, that it is very unsafe to generalise.

One point must be conceded to the "too much protection" school. In certain localities and under certain conditions fire-protection appears to be inimical to natural regeneration. But the question then presents itself: Cannot the undoubted benefits *of fire-protection be secured while providing for* natural regeneration by other means?

* Indian Forester, Vol. XXXVII, p. 394.

The solution seems to lie in improvement fellings and cleanings. It is impossible for those unacquainted with the special tracts in question to form an opinion as to the possibility of such operations on a sufficient scale, and some—Mr. H. Carter, for instance—say that improvement fellings have not, will not, or can not be carried out in the necessary amplitude. Others, *e.g.*, Mr. Troup for Tharawaddy and Mr. Walker everywhere, tell us that in spite of improvement fellings there is practically no natural regeneration in protected forests.

To the latter we may quote the statement of Mr. J. Nisbet * that improvement fellings are necessary in teak forests even when burnt over, and also the following extract from the article by Mr. Bruce, already noticed, regarding the Namme Reserve of the Ruby Mines Division† :—" This forest was once evidently the ordinary mixed teak forest with *tinwa* (*Cephalostachyum pergracile*), but has been for the last fifteen years or so intensively worked by villagers for bamboos . . . The effect of the continuous and yearly felling of the bamboo has been marvellous, practically a huge improvement felling has been done free and regularly for the last fifteen years, the result being that teak has sprung up in a way that baffles description . . . Both inside and outside fire-protected areas the effect is the same, but outside the germination is better." It seems certain, therefore, that improvement fellings properly conducted will be effective. There remains the question of the possibility of carrying them out. Though probably it will not be possible for many years to come to effect such *improvement* fellings over the whole of the vast areas of teak forest, yet the subjoined extracts will indicate that far more than has been done in the past can reasonably be expected.

"‡ The difficulty of carrying out improvement fellings has been habitually exaggerated. Two divisions in Burma last year managed 23,000 acres of good work between them."

* Indian Forester, Vol. XXV, p. 202, "Notes on Improvement Fellings for the benefit of Teak in fire-protected Reserved Forests, Burma."

† l. c. Vol. XXXII, p. 390, "The Reproduction of Teak."

‡ Indian Forester, Vol. XXXVI, p. 126, "Teak in Burma," by O. P.

"* It is generally held to be impracticable to carry out even the small amount of improvement fellings at present prescribed. Nevertheless, I will attempt to show that it would be possible to carry out a scheme of improvement fellings on a rotation of ten years, which would involve at least three times the amount of work." The author goes on to show how this can be done.

This being from the pen of Mr. H. C. Walker, we may well exclaim: "What more can the quality want?"

Just at the time he had completed this review, the writer was unexpectedly transferred to the charge of the South Coimbatore Division; it may well be imagined that he eagerly embraced the opportunity of inspecting the very forests Mr. Porter wrote about in 1894; a few remarks on *what he observed in one block may* prove interesting.

As Mr. Porter has already done so† it will not be necessary to describe the forest here. The area has been fire-protected for about thirty years, and excepting one fire over a small portion in 1907, with success. In places the canopy is far too incomplete and there is much tall grass, but it is interesting to see numerous teak seedlings forcing their way through it without being greatly affected. Even under cover teak seedlings are coming up, though it must be admitted, not very abundantly. This is being remedied by improvement fellings, regeneration operations and weedings These operations are costing less than three rupees an acre (this does not include fellings the cost of which is covered by the sales, of the material cut), and about 120 acres are worked over annually in this block.

A very noticeable feature is that very few of the teak trees are straight or sound; almost every one bears signs of injury by fire in the shape of deep-seated hollows and wounds extending right to the heart of the stem, embracing often half its girth and frequently stretching from ground level to a height of 10 to 12 feet. These injuries are far more frequent and far more severe in the teak than in any of the other species.

* l. c. Vol. XXXVII, p. 612, "Sylviculture in Burma," by H. C. Walker.

† l. c. Vol. XX, p. 285, "Failure of Natural Reproduction in the Teak Forests of the Coimbatore District."

A still more significant fact is the absence of saplings over about eight years old, though there are numerous seedlings and young plants up to that age. Now this observation seems to support the proposition made by Mr. Clutterbuck quoted on page 208, that after a lengthened period of subjection to annual fires, a forest requires a recuperative period under fire-protection before the conditions favourable to natural regeneration can be restored.

It would appear here too that for some twenty-two years fire-protection had no visible result, and that only for the past eight years have these conditions been restored and are gradually improving. It should be noted that improvement fellings and other operations have been started in this block only during the past three years, and have extended only over about one-fifth of the area.

Taking into consideration all the evidence adduced, the following conclusions appear justified :—

I. In all forests fire is harmful, both directly to the growing-stock and indirectly by the removal of the soil-covering, leading to desiccation, lack of aëration of the soil, erosion, loss of nitrogen, destruction of seeds, etc.

II. In certain forests, however, fire-protection unaided by other operations hinders the natural reproduction of the most valuable species, especially in the case of teak forests.

III. Improvement fellings and cleanings on a sufficient scale suffice to establish natural regeneration in the forests referred to.

IV. Fire-protection is essential in—

1. Forests required entirely or principally for the maintenance of the water-supply or for protection against erosion.
2. Forests where natural regeneration is secured or in which artificial regeneration is necessary or preferable.

V. Fire-protection to be really effective must be continuous.

COIMBATORE : C. E. C. FISCHER,
28th February 1912. *Deputy Conservator of Forests.*

PERIDERMIUM CEDRI AS A DESTRUCTIVE FUNGUS.

By R. S. Troup, I.F.S.

The fungus *Peridermium* (*Æcidium*) *Cedri*, Barclay, which produces the characteristic "witches' brooms" on Deodar trees in certain parts of the Himalayas, has hitherto apparently not been regarded as of much importance sylviculturally owing to the mistaken notion that the damage done by it, if any, is so trifling as to be of no consequence. This is quite true in the case of the "witches' brooms" formed on the side branches of trees, which, if few in number, cannot be considered to have any very deleterious effect on the growth of the tree.

Two cases in the Chakrata Forest Division, however, have been observed which tend to show that this fungus is by no means so harmless as is supposed. The first is that of damage done to a young Deodar plantation at Kathian, visited about six years ago. The plantation was about three years old, and it was noticed that several of the young saplings were so badly attacked as to have the appearance of "witches' brooms" growing out of the ground: the leading shoots had been destroyed, and the future of the saplings concerned was undoubtedly doomed. An extensive fungus attack of the kind might conceivably ruin a young Deodar plantation.

The second case observed was even more serious than the first. Last October I had occasion to carry out an experimental thinning in a sample plot at Koti-Kanasar, in a vigorous pure fully-stocked natural Deodar crop of large-sized poles. It was noticed that many of the poles were badly forked and misshapen at the top, and in consequence a number of otherwise promising dominant stems had to be removed in favour of smaller stems whose leading shoots were still intact; the result was a more drastic thinning than would have been advisable under ordinary circumstances. Until the marked trees were felled I was unable to account for the damage, but an examination of the felled stems at once revealed the cause to be an attack of the fungus *Peridermium Cedri*. The illustration (Plate III) shows the top of a Deodar pole affected in this way; another affected shoot on the

Photo-Mechl. Dept., Thomason College, Roorkee.

Photo by R. S. Troup.

TOP OF DEODAR POLE ATTACKED BY
Peridermium Cedri.

left has been cut off to make the photograph clearer. Poles attacked in this manner have their height-growth arrested, and are therefore of little further use in the crop: this form of damage is quite extensive in certain localities.

At Bodyar, there is a Deodar tree, some 50 feet in height, attacked by the fungus from top to bottom; it has the appearance of one immense "witches' broom."

Considering the damage which this fungus may cause if it is allowed to spread, it seems desirable to cut off all "witches' brooms" where found on the Deodar and to take advantage of thinnings and fellings to remove affected stems. Such measures should tend to check the spread of the disease.

As regards the life-history of this fungus, little appears to be known. The first sign of the disease is seen in the affected needles being somewhat shorter than the normal length, and curved. About May and June yellow flecks of spores may be seen bursting out on the surface of the needles. In October no spores are visible, but the characteristic form of the affected needles is noticeable; what happens in the intervening months I have not had an opportunity of observing. As the disease spreads, the branchlets assume the congested and stunted appearance characteristic of "witches' broom" growths, the needles gradually drop off, and the branchlets commence to die.

EXPENDITURE ON FORESTS IN INDIA.

In connection with the above article which appeared in January's number of the *Indian Forester*, we would draw attention to a paper in the Canadian Forestry Journal "On the cost of Forestry in different countries." The statistics given are instructive and we reproduce them below. The countries dealt with are Germany, France, India and the United States.

What will no doubt strike our readers is the very low expenditure in India as compared with Germany and France, and this is all the more remarkable, when it is borne in mind that in India a very heavy recurring expenditure on Fire Conservancy has to be met, absent to a great extent in Europe.

The conclusion to be drawn from a comparison of cost in the different countries are much the same as our contributor drew in his article in January's number and tend to show that as working becomes more intense and in order to induce larger returns from our forests, expenditure on them must be increased.

"A comparison of expenses in these different countries shows some astonishing differences. Prussia, with its forest of a little over 7,000,000 acres, spends each year about $14,000,000; India, with about 65,000,000 acres (including only reserved and protected forests), spends only about $4,000,000. The United States, with about 168,000,000 acres of national forests, spends only about $3,400,000. If these data are expressed in terms of the amount per acre, it is seen that the expenditure by Prussia is over $1·90

per acre as against that of the United States of about 2 cents per acre. In this connection it must be borne in mind, however, that Prussia did not expend so large a sum on forestry at the beginning of its work of organization. With the development of forestry and the increased demand for timber and the resulting high prices, it has been profitable to use more and more intensive methods and invest greater sums each year in forest cultivation. This is well illustrated in Prussia, which in 1849 spent for regularly recurring expenses about $2,000,000 each year, compared with $12,500,000 at the present time.

In other words, the expense of administration increases with the development of forestry. This is possible only when there are increased returns as a result of the increased initial expenses. This principle is illustrated in Prussia, where the net income has increased from less than $7,000,000 in 1848 to about $14,000,000 at the present time.

To carry out further the comparison of expenditures in the different countries, Prussia spends for salaries, including both administrative and executive forces, 52 cents per acre; France, 38 cents; India, a little over 2 cents; and the United States, a trifle over one cent. The average area in charge of a supervising forester in Prussia is about 10,000 acres; in the United States it is over 1,000,000 acres. While our western forests will not require a division into so large a number of administrative units as those of Prussia the contrast is nevertheless exceedingly instructive.

Although the Prussian forests are already thoroughly organized, nevertheless the work of constructing and extending roads and bridges, dams, etc., is being pushed each year with an expense of over $500,000, and that is about the sum which is now being expended on all kinds of construction work in our national forests. In other words, for construction work, including buildings, telephone lines, etc., Prussia spends about 16 cents per acre and the United States about 3·5 mills. In reality the comparison ought to be reversed, for construction work constitutes an exceedingly important part of the first organization of a forest.

The great yield of timber and large returns in money from the European forests are the result of careful, intelligent forestry. Not only are the forests protected, but they are constantly improved; they are properly thinned to obtain the best possible conditions of growth, and open areas are planted with trees when reproduction cannot be secured naturally. All of this involves expenditure of money. Such improvement work costs in Prussia $1,700,000 each year, or 23 cents per acre. Even in India there is an expenditure of over $173,000 a year for cultural operations. The expenditure in the United States is only about $50,000 for this item, a sum so small that it can hardly be expressed in terms of expense per acre.

One of the great problems in the United States is the training of men to handle the work of the national forests. At the present time the number of trained men available for the administration of the forests is entirely inadequate. The country is fortunate in having private schools which are educating men for federal service. The United States Forest Service is aiding these schools to a small extent, but the total amount expended is probably not over $1,000. This may be compared with $50,000 spent in Prussia, $37,000 in France, and $26,000 in India.

It is obvious from this brief comparison of expenses in different countries that the amount of money spent on the administration of the national forests in this country is exceedingly small, and it is perfectly obvious to any one who knows the conditions that a very much larger amount is required to accomplish the purpose of the people of the United States in managing their Government Forests.

Expenditures for Forestry in Prussia, France, India, and the United States.

PRUSSIA.

(FROM THE BUDGET OF 1908.)

Recurring Expenses:	Amount.	Per acre.
Superior staff	$1,433,590.00	$0.19
Subordinate staff	2,468,901.00	.33
Rents and expenses of offices	870,085.00	.12
Scientific work and education	96,750.00	.013

Recurring Expenses :—(*contd.*)	Amount.	Per acre.
Extraction of forest products	3,082,750.00	.42
Cultural work	1,710,500.00	.23
Construction and maintenance of buildings	598,750.00	.08
Construction of roads, dams, etc.	571,500.00	.08
Land purchase	262,500.00	.04
Administration of communal forests	492,000.00	.07
Other expenses	683,914.00	.09
Total ...	$12,521,250.00	...
Extraordinary expenses ...	*1,149,450.00*	*.16*
GRAND TOTAL ..	$13,670,700.00	...
Average ...	...	1.823

FRANCE.

(FROM THE BUDGET OF 1907.)

Recurring expenses :	Amount.	Per acre.
Superior service	$500,000.00	$0.17
Subordinate ,, ...	614,000.00	.21
Service and expenses	145,400.00	.05
Education	37,200.00	.01
Cultural and protection	243,900.00	.08
Construction work	675,200.00	.23
Exploitation	83,000.00	.02
Hunt	15,200.00	.005
Special taxes	420,000.00	.15
Miscellaneous	52,400.00	.02
Total ...	$2,876,300.00	...
Average ...	...	.945

INDIA.

(EXPENSES FOR 1907-08.)

Recurring expenses :	Amount.	Per acre.
Superior staff	$774,884.00	$0·012
Exchange compensation allowance	28,083.00	·0004
Subordinate staff (including rangers, foresters and guards) ...	704,218.00	.011
Office establishments (including contingencies)	337,171.00	.005
Extraction	1,478,176.00	.027
Roads and buildings	287,668.00	.004
Fire-protection	192,596.00	.003
Cultural operations	172,763.00	.003
Live-stock, stores, and plan	169,384.00	.002
Working-plans	28,914.00	.000

Recurring Expenses :—(*contd.*)	Amount.	Per acre.
Rent for leased forests	285,979.00	.004
Miscellaneous	69,660.00	.001
Expenditure on realization of revenue from forests not managed by the Government	7,121.00	...
Forest science and education (including all "A" and "B" charges of forest school)	26,656.00	.0004
Extraordinary expenses	179,664.00	.003
GRAND TOTAL ...	4,138,691.00	.0762

UNITED STATES.

(EXPENSES FOR 1907-08.)

Administration (for the general administration of the Forest Service) ...	$162,703.38
Use (for the use, maintenance, and protection of the national forests) ...	2,363,394.64
Improvements (for the construction and repair of permanent improvements upon the National Forests)	592,169.19
Studies (for studies necessary for the use and protection of the national forests and of other forests in the United States, and to promote economy in the use of forest products and the distribution of their results)	297,840.40
Total ...	$3,416,107.61"

REVIEW.

"JUNGLE FOLK."

(BY DOUGLAS DEWAR.)

The above is the title of the latest work by that well-known Indian Naturalist, Mr. Douglas Dewar. The book consists of a number of delightful natural history sketches, mostly of birds, which will be read with pleasure by all true lovers of nature. The author who is a keen and careful observer is not satisfied with giving ordinary descriptions of the ways and habits of birds, but discusses the probable origin, the why and wherefore, of their habits.

He has, moreover, a humorous and attractive style which is bound to captivate the reader.

On pages 7 and 8 an attempt is made to defend the Indian song-birds, and a short list is given of a few Indian songsters who, it is said, could hold their own in any company.

So far as the Shama and perhaps also the Magpie robin and orange-headed ground-thrush are concerned, we are ready to agree with the writer, but we are not prepared to class the fantail flycatcher, the white-eye and the purple sun-bird with our English songsters.

There are other Indian songsters, however, mostly, it is true, Himalayan birds whose songs would compare favourably with those of the majority of English songsters, and among these we would mention the whistling schoolboy (*Myiophoneus*), the Pekin robin (*Liothrix*), the verditer flycatcher (*Stoparola*), the ruby throat (*Calliope*), the white-collared and grey-winged ouzels (*Merula. albicincta* and *Boulboul*), the Himalayan gold-finch (*C. caniceps*), and the Kokla pigeon (*Sphenocercus sphenurus*).

On page 116 the author comments on the rarity of green in the plumage of birds, and states that it is apparently a difficult, colour to acquire.

He then goes on to say that the comparatively few birds, such as the bee-eaters, paroquets, barbets, green bulbuls and fruit-pigeons, which have acquired this colouration do not seem to require it for protective purposes, being well able to look after themselves and to be just those who are least in need of such protection.

Here we are unable to agree with him except in the case of the bee-eaters, which are never chased by hawks on account of their activity and small size. We are of opinion that green plumage is of the greatest protective value to all birds, such as the paroquets, barbets and fruit-pigeons which habitually frequent the crowns of trees.

Hawks, and specially the Shahin, are notoriously fond of paroquets, and a paroquet, in spite of his formidable bill and a green-pigeon, in spite of his pugnacity, are both equally helpless in the grip of even a moderate-sized hawk. The same applies to the barbets which are birds of laboured flight, all these species are as nearly invisible as it is possible for a bird to be when sitting motionless in the leafy canopy of a tree and would then almost certainly escape detection from a passing hawk.

When on the wing, both paroquets and green-pigeons, in spite of their fine flying powers, are very liable to the attacks of hawks.

Chloropsis may or may not derive value from his protective suit of green. He is certainly very difficult to see when sitting in his favourite spot, a bunch of "loranthus" near the summit of a tree.

On page 113 it is stated that terns do not appear to do much incubating in the day time, as the eggs are kept warm by the rays of the sun.

We are a little sceptical about this, and are inclined to believe that it is very necessary for terns to cover their eggs throughout the heat of the day, not because the uncovered eggs would get too cold but because they would get too hot, the temperature of a sandbank in the rays of the March sun being well over 100° Fahrenheit; and, moreover, they would be subjected to a *dry* heat which no eggs can stand.

A few small mistakes due to the printer's devil are the following:—

Page 38. For *palabarius* read *palumbarius*.

Page 112. For *rhynchope* read *rhynchops*.

Page 190. For "horizontal" read "vertical".

Having delivered ourselves as above, we heartily commend the book to the attention of all Indian Naturalists and to lovers of Nature among whom may be classed most members of the Indian Forest Department.

THE VALUE OF SAW-DUST.

Only a few years back saw-dust was regarded by owners of saw-mills as so much waste, to be got rid of anyhow, and as quickly as possible. Anybody could have it, and welcome. Some proprietors even paid people to cart it away. To-day all this is altered. Saw-dust, so far from being looked upon as rubbish, is greatly prized and turned to account in a hundred different ways in arts and manufactures.

Sugar, for instance, is made from it. So, too, is alcohol, which is, of course, the basis of all spirits. At a recent banquet, attended by famous chemists from all over the world, excellent "brandy" was served which had been distilled from saw-dust. It was mellow, of agreeable flavour, perfectly free from any odour or taste of turpentine, and none of the guests knew, until they were told, that it was other than the genuine juice of the grape.

Saw-dust, again, forms the basis of more than twenty different kinds of explosives. The so-called "white" and "yellow" gun-powders are merely so much saw-dust saturated with certain acids.

All kinds of dyes are now manufactured from saw-dust, and are both cheap and permanent. A pound of saw-dust dye, for instance, costs only about half as much as the same quantity of logwood extract, while possessing four times the dyeing power.—[*Wood Waste News, U. S. A.*]

OIL FROM GRASS.

A large industry in pressing oil from lemon-grass is now being carried on in the Walwanad Taluk, South Malabar, by some native capitalists who shipped recently oil valued at over Rs. 10,000 to foreign countries, where the oil, it is said, finds a ready market. The lemon grass is in abundance in the Walwanad Taluk, during all seasons of the year.—[*Commerce.*]

USES OF WOOD PULP.

"Wood-pulp is not only valuable as being the principal raw material for paper-making, it is even more valuable when transformed into wood-pulp yarn for weaving purposes, although at present the quantity used is nothing like so great." "Pulping wood," says *The Newspaper Owner*, "for paper-making makes it two or three times its value as timber, but when transformed into yarn a cubic metre of wood worth 3s. becomes worth 45s., or made into artificial silk is worth £7-10*s*."

Wooden Clothes.—A traveller in Tibet relates that he saw women wearing a garment constructed of wood. Wooden clothes, however, are not likely to be confined to Tibet if the ideas of an American inventor become popular. He has manufactured for himself and wears a fancy waistcoat of pinewood fibre, and looks forward to the time when wooden suits will be generally worn. The wood is, of course, not in its usually crude form—it is first reduced to pulp, then drawn into threads and woven like cloth. Cloth of this kind, it is stated, wears like leather, and is cheaper than the cheapest of ordinary cloth.—[*Timber Trades Journal.*]

POISONOUS WOODS.

A number of woods show in less or more degree during their technical use disturbances of health. Some of these are woods which possess neither odoriferous nor colouring matter, and the opinion that these bodies are the source of the poisonous action is, therefore, untenable. Amongst indigenous woods, the following possess poisonous properties :—*Taxus baccata, Juniperus Sabina, Cytisus laburnum, Rhus tiphina, Rhus botinus,* and *Coriaria myrtifolia.* These, however, are seldom used, and then only in small pieces. Of foreign woods, poisonous properties have been found in *Buxus sempervirens, Hippomane mancinella, Excœcaria Agallocha, Amyris balsamifera, Convolvulus scoparius,* and *Santalum album,* and various satin woods.—J. Grossmann (*Bayr. Ind-u. Gewerbebl.*, 1910, 51; through *Jahresber d. Pharm*, 45, 12, 1911).—[*Pharmaceutical Journal and Pharmacist.*]

A NEW USE FOR CACTUS.

A Consular report from Montevideo suggests that the people of the south-western United States, where cactus is abundant, and often a nuisance, might follow the example of the Uruguayans and utilize this plant in making whitewash. When travelling through the rural districts of Uruguay one's attention is attracted by the fine white color of the farm buildings, even during the wet season. The whitewash is made from the sliced leaves of the common cactus, macerated in water for 24 hours. To the creamy solution thus produced lime is added. When applied to any surface, a durable pearly white appearance is produced.—[*Scientific American.*]

THREE MILLION MATCHES A MINUTE.

It has been estimated that, for each minute of time, the civilized nations of the world strike three million matches. This is said to be average for every minute of the twenty-four hours of the day. Fifteen hundred billion is the number for the entire year, and those persons who live under the American flag are charged with the consumption of one-half of this amount.

The importance of the industry which turns out the little splinters of wood tipped with sulphur or some other material ignited by friction, is only recognized when the average smoker tries to contemplate his predicament if he had to go back to the time when he had to coax a spark from a tinder-box. Small and insignificant as it is, the match demands as much attention in the choice of the wood involved in its manufacture as any other forest product. Only the choicest portions of the best trees are suitable. Sap-wood, knotty or cross-grained timber will not do. Instead of being a by-product, the little match is turned out at hundreds of mills over the country where the by-products are bulky objects like doors, sash, shingles, sidings, posts, and cord-woods. The pines, linden, aspen, white cedar, poplar, birch and willow are the most suitable match timbers.—[*Scientific American.*]

BITTER PRINCIPLE OF *ANDROGRAPHIS PANICULATA.*

Andrographis paniculata has a reputation in Java as a remedy for snake-bite. By extracting the leaves with alcohol, a lactone, $C_{20}H_{30}O_5$, has been isolated and named *Andrographolide.* It is converted into salts of andrographolic acid on boiling with caustic alkalies.—K. Gorter (*Apoth. Zeit.*, 1911, 26, 954).—[*Pharmaceutical Journal.*]

CAUSE OF FLOOD FERTILITY.

A new theory of the great fertility of alluvial soil has been brought to the notice of the Royal Microscopical Society by Rev Hilderic Friend. It is usually explained that the fresh soil brought by occasional floods keeps up the richness of the land, but now the real cause is affirmed to be the vast numbers present in the mud deposit of a tiny worm that buries its head and waves its tail above the surface. In some places an ounce of ooze has been found to contain a quarter of an ounce of these worms.—[*Capital.*]

COUNTERFEITING METHODS IN UNITED STATES LEATHER INDUSTRY.

H. M. Consul at Philadelphia (Mr. W. Powell) has furnished the following particulars of counterfeiting methods used in the leather industry in the United States :—

The United States Bureau of Chemistry has recently been investigating various methods employed in the leather industry. It is estimated by the official experts that at least half, probably more than half, of all leather that comes into the market in the shape of boots, shoes, harness, bookbindings, etc., is a counterfeit of what it purports to be. A bull's hide is split into half-a-dozen thicknesses, these being used to counterfeit various kinds of leather, such as kid and crocodile skin. In the shoe trade, leather known as "Box Calf" is made of this split hide, and is largely employed for making boots and shoes of the cheaper grades. Pigskin is also imitated in the split leather ; it is possible to buy false pigskin

leggings at from 12*s*. to 16*s*. a pair. The leather is stamped by a special machinery which gives it the apparent grain of pigskin. Indeed, the little holes from which the bristles have been removed are counterfeited; the imitation may be detected, however, from the fact that the holes are not to be found inside the leggings. The use of stamping machinery has enabled the manufacturer to counterfeit with great accuracy almost any kind of leather, especially when the split bull's hide is used. A very large proportion of the "crocodile skin" bags are of this material. Cordovan leather is least liable to imitation owing to the difficulty of reproducing its appearance.

With regard to the adulterants used on leather, the chief among these is glucose obtained from corn starch, employed to increase the weight. This glucose is sometimes brushed on the leather or added to the leather in a revolving drum. A frequent adulterant is Epsom salts, which is stated to clear the grain and render the material brighter in colour. The treatment, however, is very harmful, destroying, as also does treatment with glucose, the waterproof quality of the leather. The weight of leather may be increased by the application of Epsom salts as much as 12 per cent.

An even worse method of treating leather is to put in an excess of tanning material, comprising tannin and the related compounds of sugar and organic acids. This will often increase the weight of the leather by as much as 20 per cent. The leather is at first fairly water-tight, but constant use soon washes out the superfluous tannin, and the material, which by the treatment is rendered harder and stiffer, is likely to crack and break in the creases.

What is called sophistication is the common practice of bleaching the leather by means of alkalies and sulphuric acid. If, as very often is the case, some of the free sulphuric acid remains in the leather, it has the effect of burning the tissue and causing its disintegration, so that it breaks easily. The acid also makes the material harsh and brittle, sometimes softening the surface, which is easily rubbed off. Alkalies also render the substance of the

leather hard, and easily cracked and broken. The object of this bleaching is of course to improve the appearance of the leather, which, as it comes from the tanyards, is apt to be dark and often blotchy in appearance.

A frequent practice of boot manufacturers in the United States is to put the leather on an emery-wheel, thus scratching off all the grain or outside surface, in order to render the leather more attractive in appearance.

Large quantities of paper are used in the manufacture of boots and shoes of cheaper grades, which are given an outer cover of a mixture of leather scraps and pulp paper moulded into the required shape. This mixture is treated with oil, rubber and glycerine, the last-named ingredient serving to soften it, whilst the others tend to make it waterproof for a certain time.

There appears to be no law in the United States which can prevent the adulterations and manipulations carried on in the leather trade. The Bureau of Chemistry, however, is working to acquire a knowledge that will bring about a more intimate appreciation of the fundamental principles of leather-making. It is endeavouring to find out how to obtain a greater percentage of tannin from the tan bark, and to discover and explain to leather-workers the action of bacteria of the various kinds used in the manufacture of leather. No exact knowledge on these matters has hitherto been attained.

With the growing scarcity of leather, there is much need of a substitute, but no satisfactory one appears to have been produced. Some imitation leather fabrics have been applied to the manufacture of valises and portmanteaux and hand bags of the cheaper kinds. Most of the fabrics are produced by the use of sulphurated linseed and other oils, sometimes with an admixture of a solution of rubber, applied to canvas or cotton cloth ; and they are not suitable for foot-wear.—[*The Board of Trade Journal.*]

SHOOTING IN BURMA.

In the beginning of this year I was instructed to go and do markings in the Mahuya and Paunglin Reserves, which lie on the eastern slopes of the Pegu Yomas, and in which the two chaungs the Paunglin and Mahuya take their rise, and uniting, eventually form what is commonly known in Burma as the Pazundaung creek. When I arrived at my destination, the villagers round about came and gave me thrilling accounts of the many tigers and elephants which roamed about the surrounding forests. As the latter class of animals may not be shot except under certain conditions, and as I had never shot a tiger and was very anxious to do so, I gave all my spare attention to the former class. I tried again and again to purchase a buffalo or cow-calf to put out as a bait, but the villagers refused to sell me even one. I was thus forced to rely on the chance of finding a kill of a wild animal in the forests. I was rather lucky in this, as, about three weeks after I had arrived, one of my men one morning came upon the body of a sambur stag which had been killed by a tiger on the previous day. In the course of the day I had my *machān* erected on a conveniently situated tree and at about 4-30 P. M. I started off for the kill accompanied by two Burmans. When I arrived there, to my great surprise I came face to face with the tiger having its meal. However, before I could get a shot, stripes was off. I felt inclined to return to my camp, thinking that the beast would not come back that evening, but acting on the advice of my Burmans, I changed my mind and went to the *machān* followed by my men. We had hardly been seated for half an hour, when I saw the huge cat coming stealthily along towards the kill, taking cover most carefully for about four or five seconds behind every bush it came across. As it approached nearer and nearer to the kill, I gradually brought my rifle up to the present, and as soon as it came into the open near the carcass, I aimed for its heart and fired. As soon as I had done so, the beast gave a wild jump, let out a loud roar and rolled over. At first I thought it was dead, but after a short time it got up and disappeared from sight into the thick undergrowth. As it was getting dark by then I

decided not to follow up the wounded animal, but returned to camp as soon as possible. The next morning, accompanied by almost all the villagers who having heard of the affair had early flocked to my tent, I went in search of the tiger. When we came to the site to my great astonishment I found that the kill had been dragged during the night. This could mean either I had not mortally wounded the tiger or else there was another animal feeding on the kill. The first supposition was soon dispelled, for we soon after struck the trail of blood and found stripes lying cold and stiff in a chaung close by. It was a tigress I had shot, and it measured 8 feet 6 inches. The bullet had gone clean through its body, and it must have died shortly after we had quitted the *machān* the evening before. The Burmans and Karens then told me that its pair must be the animal which had dragged the kill during the night. I immediately had another *machān* erected and went off to work. I went out to the kill that evening at about 3-30 P.M., but when I arrived there I found that the body had been dragged again by the beast during the day. To enable me to see the carcass clearly from the *machān*, I had the place around it slightly cleared, but whether this cutting frightened the animal or not, nothing turned up that evening, although I sat up till it was too dark to see. The tiger, or whatever it was, came, however, the same night and dragged away the kill again. I had another *machān* erected near the new spot and sat up again that evening. When it was almost dusk, to my great surprise, instead of a tiger a huge black bear shambled out from the undergrowth and started eating at the carcass. I soon settled him with a shot through his breast. I then naturally concluded, that it must have been the bear that had dragged the body of the deer the day before. But the Burmans and Karens would have it that it was a tiger and even showed me fresh pug marks of the huge cat. They also solemnly stated that the tiger had not come because it was afraid of the bear, and that it would come again now that the latter was dead. I may here state that when I was skinning this animal the villagers were very keen on getting hold of a part of the intestine they called the *the-gay*. I do not know exactly what organ of the bear's body

it is, but it was considered very valuable as a medicine by the people, and one villager even offered me Rs. 5 for it. He was greatly surprised when I declined to sell it to him but gave it away *gratis* to the man who had helped me most in the shoot. Well, to revert again to the kill, I found the next morning that it had been dragged yet again, and I was thoroughly astonished. In the evening I sat up again on a newly-made *machān*, but it was in vain as nothing appeared. The next evening, however, I was more fortunate, but again, instead of the expected tiger, another black bear came to the kill, and I easily disposed of him. Over the same kill I sat up after this for two more evenings, but I did not see anything more. By the end of that time the carcass had become putrid and had almost all fallen to pieces. I was exceedingly pleased at my good luck, as I have been little over seven months now in Burma.

A. J. BUTTERWICK,
E. A. C., Forests.

TURPENTINE AND ROSIN MARKETS.

TURPENTINE.

Messrs. James Watt & Son report as follows :—The persistent rise during 1910 increased in intensity until late in March 1911, when record quotations since the war of secession were registered for American spirits, *viz.*, 107c. per gal. in Savannah; 74*s*. 3*d*. per cwt. in London. Dear turpentine during the early months of 1911 was a corollary of the two poor crops of 1909 and 1910; but the above prices were certainly unduly inflated; the trade, on both sides of the Atlantic, strongly resented them; the upshot was a larger use of substitutes than has ever been known. This popularity of substitutes, and the larger crop in America, brought about a remakable fall, *viz.*, from 107c. in March to 44¼c. in November in Savannah, and from 74*s*. 3*d*. in March to 33*s*. 9*d*. in November in London. The rapidly increasing production in America of high grade turpentine made from pine stumps is attracting considerable attention; it has found such a ready market

in the United States in 1911, that the supply in 1912 will be vastly increased. Towards the end of 1911 we received sample shipments of this stump turpentine to London, which met with a flattering reception, and the import to the United Kingdom in 1912 bids fair to be on a large scale. In view of the rapid rate at which the eligible pine forests in the United States are disappearing before the lumberman's axe, whereas the demand for turpentine by varnish and paint makers is constantly growing with the increase of population and wealth of the world, we look upon the advent of this stump turpentine as a great boon, because by broadening the base of supply it will tend to give greater stability to prices. Such fluctuations as those noted above cannot but be detrimental to the trade. There is, probably, ample room for both gum-distilled and wood-distilled turpentine on the markets of the world.

HIGHEST AND LOWEST TURPENTINE PRICES IN LONDON.

	1909.		1910.		1911.	
January ...	... 28/9	30/9	40/6	43/3	56/—	57/9
February ...	... 27/3	30/—	41/—	42/9	57/9	63/6
March ...	... 26/—	27/—	41/6	42/9	63/3	74/3
April ...	... 25/6	28/—	42/—	44/3	62/—	71/—
May ...	... 26/6	29/3	42/9	44/9	46/—	64/—
June ...	... 28/—	32/9	42/6	44/9	43/—	48/—
July ...	... 33/9	36/—	45/—	50/6	37/6	39/—
August ...	... 36/—	41/—	48/9	51/6	36/6	39/9
September ...	... 39/9	43/3	51/3	54/6	38/—	39/4½
October ...	... 40/6	42/9	53/3	56/—	35/—	38/3
November ...	... 39/9	41/—	54/—	55/9	33/9	35/9
December ...	... 38/6	40/9	53/3	56/—	35/9	37/6

The average price of American turpentine in London was :— 1905, 45*s.* 7*d.* ; 1906, 47*s.* 3*d.* ; 1907, 44*s.* 3*d.* ; 1908, 31*s.* 9*d.* ; 1909, 33*s.* 11*d.* ; 1910, 47*s.* 8*d.* ; 1911, 47*s.* 9*d.* (The average for 1891-1900 was 25*s.* 2*d.* ; for 1909-10 was 39*s.* 4*d.* ; for 20 years 1891-1910, 32*s.* 3*d.*)

The total exports from France were (in tons of 1,000 kilos.) : 1905, 12,214 ; 1906, 12,922 ; 1907, 9,754 ; 1908, 9,212 ; 1909, 9,220 ; 1910, 10,954 ; 1911 (11 months), 9,207.

The total exports from United States were as under :—1905-06, 49,482 ; 1906-07, 47,181; 1907-08, 54,800 ; 1908-09, 61,093; 1909-10, 46,747 ; 1910-11, 44,835 ; 1911 (April to October, seven months), 37,717. The American crop year begins April 1st and ends March 31st ; 320 American gallons, calculated as one English ton, equal 1,016 kilos.

TURPENTINE IMPORTS INTO GREAT BRITAIN.

From—	1906.	1907.	1908.	1909.	1910.	1911.
United States ...	19,960	19,593	25,184	18,298	18,264	18,181
France	1,535	989	1,291	1,020	1,138	1,183
Spain and Portugal ...	...	...	327	69	339	260
Russia and Scandinavia	4,139	4,910	1,849	2,752	3,777	4,344
All other Foreign Countries ...	8	23	33	30	94	38
Tons of 1,016 kilos ...	25,642	25,515	28,684	22,169	23,612	24,006

Percentage from—	1906.	1907.	1908.	1909.	1910.	1911.
United States ...	77·84	76·78	87·79	82·54	77·35	75·73
France	5·99	3·88	4·50	4·60	4·82	4·93
Russia	16·14	19·24	6·45	12·41	16·00	18.10
All other countries ...	·03	·10	1·26	·45	1·83	1·24

STOCKS OF TURPENTINE IN LONDON AT THE END OF EACH YEAR.

	1906.	1907.	1908.	1909.	1910.	1911.
American (barrels) ...	18,467	24,614	45,912	26,735	20,488	24,686
French („) ...	2,544	1,051	4,601	3,680	2,559	1,569
Spanish („) ...	...	...	636	299	956	276
(„) ...	21,011	25,665	51,149	30,714	24,003	26,531
Afloat	800	7,750	600	3,500	2,100	14,188
Barrels	21,811	33,415	51,749	34,214	26,103	40,719
Price in London ...	50/3	32/3	29/3	40/6	56/-	37/4½
Price in Savannah ...	67½c.	40½c.	38½c.	56c.	77c.	50¾c.

ROSIN.

The price of common strained rosin, like that of turpentine, soared to record heights in the spring of 1911, but the subsequent reaction of the former was much less severe, as a glance at the table will show. The year closes with common strained at 17*s.* ex wharf, London, and ·7 at Savannah ; against 14*s.* 9*d.* ex wharf, London, and 5·90 at Savannah, end of December, 1910; against 10*s.* 3*d.* ex wharf, London, and ·4 at Savannah, end of December,

1909. The extension of the cup system of tapping the pines in the United States means a smaller yield of dark grade rosin, and it is the darker grades that are most in demand. We, therefore, see the prices of finest and dark rosins tend more and more to approximate. One of the new processes of wood distillation produces a fine clean ruby rosin; late in the year 1911 we imported to London some of this stump rosin, which has given great satisfaction to those who have tried it; like the stump turpentine, it promises to be a valuable and much needed adjunct to the supply but the quantity produced is relatively small. The Customs Board of New York has not yet made the final pronouncement on the question of the duty on rosin imported to the United States. It will be remembered that the decision of the Court of Appraisers in October, 1910, was in favour of the repeal of the duty. It is the appeal against this decision which is now *sub judice.*

AVERAGE MONTHLY QUOTATIONS OF STRAINED ROSIN.

Price per cwt. = 50¾ kilos. ex wharf, London.

	1906.	1907.	1908.	1909.	1910.	1911.
January ...	9/7½	10/6	9/6	8/3	10/4½	15/9
February ...	9/6	10/9	9/7½	8/4½	10/9	17/3
March ...	9/9	10/10½	9/6	7/10½	10/7½	18/9
April	9/9	10/10½	9/6	8/—	10/9	19/3
May	10/1½	11/–	8/4¼	8/1½	11/–	17/3
June	10/1½	10/10½	7/10¼	7/9	12/—	16/—
July	9/9	10/7½	7/10½	8/—	14/—	14/6
August ...	10/—	10/6	7/4½	8/4½	14/6	14/7½
September ...	10/3	10/6	7/1½	9/4½	14/9	15/6
October ...	10/4½	10/3	7/4½	10/2	15/1	15/6
November ...	10/4½	9/9	7/9	10/1½	14/9	15/4½
December ...	10/3	8/9	8/3	10/—	14/8	16/1½
Average of year ...	10/—	10/5	8/4	8/8	12/9	16/4

Total exports of rosin from France (in tons of 1,000 kilos.) :— 1906, 37,888; 1907, 37,931; 1908. 49,230; 1909, 57,234; 1910, 55,751; 1911 (11 months), 64,608.

The total exports from United States were (in tons of 2,240 lbs. = 1,016 kilos, net weight) :—1905-06, 241,243; 1906-07, 270,990; 1907-08, 277,707; 1908-09, 229,336; 1909-10, 209,934; 1911 (seven months, April—October), 152,158. The American crop year begins April 1st and ends March 31st.

ROSIN IMPORTS INTO GREAT BRITAIN.

	1906.	1907.	1908.	1909.	1910.	1911.
From—						
United States ...	66,043	66,295	55,989	50,310	48,381	50,089
France	11,793	11,780	19,056	14,610	16,987	13,250
Spain and Portugal ...	3,816	4,607	6,440	5,298	8,160	8,644
All other countries ...	884	126	641	781	1,503	2,288
Total tons of 2,240 lbs. (1,016 kilos). ...	82,536	82,808	82,126	70,999	75,031	74,271
Percentage from—						
United States ...	80·02	80·06	68·18	70·86	64·48	67·44
France	14·28	14·23	23·20	20·58	22·64	17·84
Other countries ...	5·70	5·71	8·62	8·56	12·88	14·72

Spelter (from the circular of Henry Murton & Co.)—The output of spelter from Europe, Australia and the United States for 1911 and 1910 was as follows :—

	1911. Tons.	1910. Tons.
Belgium	192,000	169,900
Holland	22,400	20,600
Germany—East	153,700	138,000
" West	92,700	86,100
Great Britain	65,900	62,100
France and Spain	63,200	58,200
Austria and Italy	13,700	13,100
Poland	9,500	8,500
	613,100	556,500
Australia	1,000	500
United States	263,300	246,700
Total ...	877,400	803,700

The total production of spelter thus shows an increase of 73,700 tons, Belgium being the principal contributor to this result. The imports of spelter into England decreased by 5,900 tons last year. The average price of the metal in 1911 was £25 3*s.* 2*d.*, an advance of £2 3*s.* 2*d.* on 1910 and the highest since 1906, when the figure was £27 1*s.* 5*d.*—[*The Indian Trade Journal.*]

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JUNE, 1912.

FORESTRY IN NATIVE STATES.

A perusal of the annual reports of some of the Native States has left an impression on our minds that is not altogether pleasing. The prevailing tone too often seems to indicate a kind of "inertia", the spirit is willing, but the power behind it is at times insufficient to drive through the reforms that in one shape or another seem to be called for. Nor is this to be wondered at. The Conservators are not so well paid as a rule, nor have they the same standing as in British India, and consequently do not carry the weight with the Indian Chiefs and their Durbars that we should like to see. They are further greatly handicapped by their establishments, or often by the want of such, and find it difficult to induce the Durbars to see things in the same light as they do. Durbars are somewhat timid as regards spending money, especially if they are doubtful as to any immediate return; they are also liable to have too little confidence in the proposals made by their Conservators. All this points to the need of a supervising and advisory force behind the Conservator which will, on the one hand, prevent the acceptance of any ill-considered line of action that may be suggested by him, and

on the other, convince the Durbar of the expediency of accepting well-thought-out proposals bearing on their Forest administration The Political Department may be unable to render any efficient aid in the matter, since its officers are not seldom ignorant of the lines of Forest administration, although in many cases entirely sympathetic and much interested in Forestry and aware of the benefits that a well-considered policy confers on the people.

Our remarks must not, however, be taken to be of universal application, since in somewhat isolated instances, *e.g.*, Kashmir, Mysore, etc., forest administration has been placed on a firm basis and the forest resources of these States are being efficiently looked after, but we are afraid that in the majority of cases this is doubtfully the case. The question then which we wish to bring forward is how to remove the "inertia" that often undoubtedly exists, how to assist well-meaning and often efficient Conservators, how to inspire Durbars with the confidence that proposals put before them for improving forestry in their States are on the right lines, and how to assure them that if they put down money with a view to the development of their Forest policy, this expenditure will be fully justified and a watchful eye kept on it by Officers in the highest degree qualified to advise them. It is of no use proposing that highly-paid Officers from the British Service be deputed to each State as Conservators, the smaller States are not always in a position to pay their salaries, nor probably are Officers available, while many able British and Indian Officers already in the service of the Native States would feel that an unmerited slur had been cast on their capabilities.

Our proposal is that the services of experienced Officers of the British Service should be lent to groups of States. Such might be termed their Consulting Conservators. If this were done the States would have to be grouped, possibly one group might comprise those in the Central India Agency, another those in the Rajputana Agency, and so on. The salary of each such officer might be divided up by mutual agreement among the various States benefiting by his advice and would thus form a comparatively small charge on any individual State, and one that it would

not be difficult to meet. We believe that such appointments would be welcomed by the Indian rulers and by their Conservators and would be of immense benefit to the various States concerned. A Conservator in a small State is much handicapped by want of experience outside his own particular charge and would no doubt be glad of advice from an independent and competent source. A Durbar might be doubtful about accepting proposals made by its Conservator; if, however, an advising officer of mature experience could show that the proposals were sound and had borne good fruit elsewhere, it should not be difficult to convince the Durbar of the advisability of adopting them in its own interest.

Native States, moreover, often have difficulty in obtaining trained Officers: the Dehra College is full to overflowing, and generally cannot meet their applications, while trained men who offer themselves for appointments are too often the lame ducks of the British Service. Besides, such States are out of touch with the Dehra College and Institute and naturally find it impossible to keep pace with the improvements in Forestry that are gradually showing themselves in British India, they feel themselves neglected and not without reason; they have been invited to pursue an enlightened forest policy, and when they try to do so they find themselves discouraged by want of trained officers and the impossibility of obtaining such, by want of advice and by want of sympathy generally. We believe that all this can be obviated by the deputation of Imperial Officers to fill appointments of Consulting Conservators to groups of States, and that by this means not only could schemes yielding, among other things, increased revenue for the present and still larger increase in the future be initiated, but the forest policy of the empire would be consolidated and intimate relations be established between forestry in British India and Native States, to the mutual benefit of both. We should like to see Native States sounded on the subject through their Political Agents and a test group of States formed with its Consulting Conservator chosen for his tact and breadth of view. There are no doubt officers well suited for such a post, but the selection would have to be very carefully made, as we are sure

it would be, and the new departure considered in the first instance as tentative only. We cannot but think that if the Government of India were approached on the subject by a Native State or States, their representations would receive a sympathetic hearing and be likely to be favourably considered, and to Conservators in Native States we put forward the suggestion that they should encourage their Durbars to move in the matter.

As a precedent, we believe that the British Government lends to groups of States officers of the Public Works Department as Consulting Engineers, who, while refraining from interference with the State Engineers, carefully supervise all projects involving any considerable expenditure and whose advice is thoroughly trusted by the States concerned. Why should not a similar course be pursued in the case of the Forest Department? It seems to us that there is every reason why it should.

THE NEW METHOD OF RESIN TAPPING.

There appeared in *Capital* of the 7th December 1911 an article drawing the attention of Local Governments to a new method now adopted in certain parts of America of tapping Pine-resin, with the help of Gilmer glass cups. The article in question

leads the reader to believe that the wasteful methods hitherto employed in America and those now employed in India eventually result in the 'untimely end'—to use the writer's words—of even the finest Pine trees.

It is by no means instructive though somewhat amusing to read such statements, for one would have thought that even Indian Forest Officers could hardly have been accused of killing the goose or tree—whatever you like to call it—which lays the egg, in this case a resinous one.

The method of tapping adopted in India, with modifications to meet the local requirements, is that employed in France, which the senior men of the Indian Forest Department were taught at the National Forest School at Nancy, during their course of training on the Continent. To understand this method of tapping, the writer of the article in *Capital* might with benefit peruse the rules now in force for tapping in the Naini Tal Division. For reference they are given at the end of this article, and if any body doubts their suitability in practice, they can easily convince themselves that the trees do not come to an 'untimely end' by inspecting the tapping operations in the forests to which these rules apply. The tapping is most carefully regulated, and in order to prevent the trees deteriorating, the rules lay down that the tapping of any tree shall only be carried out for five years, after which the tree shall be given a period of rest for ten years.

And now to turn to the new method of tapping with the Gilmer glass cups. It may at once be said that the method is of sufficient interest to attract serious notice. It is understood that experiments have already been started in this connection in the Punjab forests, and similar experiments are contemplated in those of the United Provinces. The United States Forest Department, who are always ready to give help when asked to do so, have already sent the Conservator of Forests, Western Circle, United Provinces, a report on the results they have obtained by tapping Pine with the help of the new glass cup. It is by the courtesy of the Conservator of Forests, Western Circle, United Provinces, that it is possible to give a copy of this interesting report, received

from the Director of the Forest Products Laboratory, Wisconsin, America.

"The Forest Service hung 250 of the Gilmer glass cups on four grades of timber in the Choctawhatchee National Forest with the following results :—

Grades.	Weeks.								
	1	2	3	4	5	6	7	8	9
	c. c.	c. c.	c. c.	c. c.	c. c.	c. c.	c. c.	c. c.	c. c.
Slash pine ...	268·5	396·5	456	541·0	593	611	649	727 5	875
Good yellow pine	144	230	310·5	310·5	310·5	310·5	310·5	310·5	310·5
Medium yellow pine	85	120	155	155	155	164	191	191	230
Poor yellow pine ...	85	94	120	155	155	164	182	191	220

"This cup does reduce the fire risk, prevent loss of gum, and contamination with dirt, but only the highest grade of best flowing timber will yield sufficient gum to render the use of this cup remunerative so far as the experiments of the Forest Service extend.

"The glass cups with directions for hanging them may be obtained from the Gilmer McCall Turpentine Cup Company, Mobile, Alabama."

It will be seen from this report that even the American Foresters are as yet by no means convinced as to the enormous superiority of this new method of obtaining the resin from Pine trees. There is another point which is not touched on in the American report, and that is, that the holes bored obliquely into the timber of the tree can never be again filled with woody tissue, though the end may be closed over and the remaining cavity filled with resin. Thus from a timber-yielding point of view the tree must inevitably be much injured, more so even than by the present method of tapping by which the external wounds are covered over within ten or fifteen years of being blazed.

"RULES FOR TAPPING IN THE NAINI TAL DIVISION AS AT PRESENT IN FORCE.

"The following revised tapping rules are circulated for guidance :—

2. Attached is a statement showing the areas so far set aside for tapping. Early in he year the trees in the areas set aside for tapping will be numbered with a serial number as the numerator and the numbers of the channels as the denominator, *e.g.*, 2674/2 which means that 2674 is the serial number and 2 the number of pots the tree is to carry. Each compartment will have a series of its own. The Forester or a trusty Forest Guard can number the compartments to be light tapped and the Range Officer those compartments to be heavy tapped. Heavy tapping will be only carried out in those areas to be felled for firewood within the next five years and only those trees in them will be heavy tapped that are to come out at the felling, the remaining trees in the coupe being light tapped.

Number of pots per tree.

3. *Light tapping* :—One pot for trees between $3\frac{1}{2}'$ and $4\frac{1}{2}'$ in girth.
Two pots for trees between $4\frac{1}{2}'$ and $7'$ in girth.
Three pots for trees over $7'$ in girth.

Heavy tapping :—One pot for every foot in girth of bark.

Method of tapping : *Hanging of the pots.*

4. Having arranged for pots, tools and lips, the pots will be hung on the trees as follows. Choose places for the pots at the base of the tree, taking care that when two or more pots are prescribed that they are equidistant from each other, then cut a channel 4" wide by 1" deep and about 6" long at the base, so as to allow a free hang to the top, place the lip (a piece of thin iron sheet 5" by $1\frac{1}{2}$") in a curved incision (made by a special chisel with that curve), care being taken that the lip slopes downwards from the tree and underneath towards a side drive in a nail on to which the pot will be hung.

The channel when first cut should be 4" to 6" long above the lip. For the cutting of a channel an ordinary *sharp* adze is required. When commencing work for the year on trees already tapped, the old lip will be extracted and inserted at the head of the previous year's channel, the pot being hung below it as before.

Freshening.

5. For this a *very sharp adze* (Basula) is required. As the flow ceases, which, according to the time of year, may be after one, two or three weeks, a point on which the Range Officer and Beat Guards must be particularly careful, the channel will require freshening at the top. This is done by the removal of a thin shaving not more than $2\frac{1}{2}$" of the vertical length of the tree. The flow has ceased because of the clogging of the outlet of the resin ducts, and all that is necessary is to remove those clogged and to open out other ducts—the ducts more or less ramifying through some 2" or so of outer wood in a vigorous 1st class tree.

No hard-and-fast rule can be fixed as to the length of the channel to be cut each year, as this depends on the extent of the freshening necessary and on the tree itself as a resin-producer. A maximum of 15", however, is fixed ; but the less the better, as the longer the use of the ladder is postponed the more quickly can work be done.

The cutting of the bark on the sides of the channel is not allowed; simply remove the old pieces of loose bark by hand and put a piece of bark over the pot itself to prevent foreign matter falling into the resin.

Collection.

6. As the pots become full they must be emptied of their resin. Here again no fixed period can be fixed, but during the season of greatest flow once every fifteen days is necessary, but otherwise not less than once a month. As a rule, the resin should not be allowed to reach within ½" of the nail hole or the top of the pot, whichever is lowest.

The collection will be made by means of wooden spoons, the resin being put into kerosine oil tins fixed up with a handle, which will be emptied into other tins at convenient centres for transport to Bhowali.

7. Tapping will go on for five successive years between about the 15th March and 15th November according to season and then a rest of ten years, so that during fourteen years the 4" channel should be closed over by callous formed on the sides."

R. S. PEARSON, I. F. S.,
Forest Economist.

TURPENTINING IN FLORIDA ON AN AMERICAN NATIONAL FOREST.

BY THEODORE S. WOOLSEY, JR.

To thoroughly understand the policy and methods that underlie Federal turpentine operations in Florida, it is well to first give a general *resumé* of conditions.

The (Choctowhatchee) Florida forest where operations have been commenced is situated in southern Florida, near Pensacola. The ground is unusually level, rising from tide water to an extreme elevation of perhaps 300 feet. The forest is bounded on one side by tide water and is drained by numerous streams. The grazing business is unimportant and does not seriously affect the management. There is some forest settlement although the sandy soil has prevented extensive agriculture. The fire protection has not proved a success, and because of the expense it is to be restricted to those areas where the turpentine operations have commenced. The free use of fuel wood is practically unrestricted, because the small population uses an inappreciable amount and because the pitch faggots used are not only of no value, but actually a fire menace. There are no timber sales at present. Forestation has been started and consists mainly in sowing maritime pine and dibbling cork oak. The present stand is chiefly over-mature long leaf pine of slow growth and small size. It rather resembles a stand of chir pine growing on an unfavourable situation in the Himalaya Mountains.

The main business locally is turpentining and much of the Federal land was alienated and patented under the Homestead Act before the forest was proclaimed. The (Choctowhatchee) Florida forest was first put under administration early in 1910, and during the first year the turpentine leases gave a gross revenue of $4,238·50 and during the year ending June 30th, 1911, the leases amounted to $8,268·68. The privilege of boxing long-leaf pine was first advertised at a minimum rate of $65·00 per thousand cups for a period of three years. The price has risen, however, owing to an unusual demand to $100·00 per thousand cups for three years. The working season lasts from March 1st to

November 1st. A streak is cut each week, giving a series of incisions at the end of the season about three feet in height. The gum is dipped every four weeks and the scars are scraped at the end of the season.

In accordance with conservative methods * of turpentining, the Forest Service insists upon the use of some satisfactory cupping system. In other words, the old-fashioned gash at the foot of the tree to catch the resin is no longer allowed. No cups are sanctioned on long-leaf pine less than 11″ in diameter; but one cup on trees 11″—15″; two cups on trees 16″—20″; three cups, but no more, on trees 21″ and over. The restrictions imposed allow "faces" 9″—14″ wide, and the operator must leave strips of bark or "bars" 4″—6″ in width between each face. The inspector must see that the "faces" be of uniform width and depth. A complete working-plan has already been made for the forest, and the yield in cups is calculated on the following basis for the average acre:—

1—3	years,	20 virgin cups;
4—6	,,	20 high-face cups;
7—9	,,	three year period of rest;
10—12	,,	10 back cups;
13—15	,,	10 high-face back cups.

It will probably be at least ten years before the full cupping privileges on the forest are utilised. It is expected that after these fifteen years of cupping the tree will be ready for the axe, and can be readily sold to sawmill men. In the ordinary contract, the operator is required before January 1st of each season to rake a cleared space, of about two and one-half feet in diameter, around the bottom of each tree, and a fire-line at least 3 feet in width around the entire turpentine operation. The following sample contract gives an excellent idea of the requirements imposed in all leases:—

United States Forest Service, Florida National Forest.

TURPENTINE PERMIT.

____________________191____

IN CONSIDERATION of the granting to________of this Permit to work for turpentine certain longleaf and slash pine timber on

* **Based on manuscript data compiled by A. B. Recknagle and I. F. Eldredge.**

an area to be definitely designated by a Forest Officer before cupping begins, located in ________________

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____

Tallahassee Meridian within the Florida National Forest, estimated to contain ________________cups more or less________ do hereby promise to pay to the First National Bank of Albuquerque, New Mexico, (U. S. Depository) for said Permit at the rate of ________________($________) dollars per thousand cups in ________________ payments of at least________________ of the total amount due, credit being given for the sums, if any, hitherto deposited with the said First National Bank of Albuquerque in connection with this Permit ; and____________ FURTHER PROMISE AND AGREE, should this Permit be granted to__________to work said timber in strict accordance with the following and all other related regulations governing the National Forests and prescribed by the Department of Agriculture :—

1. Timber on valid claims and timber under other contract is exempt from this Permit.

2. No tree will be cupped, chipped, raked or worked in any manner until the first payment has been made.

3. No gum or other product of the timber will be removed before the cups on the area have been counted and recorded. Title to the product of the timber included in this Permit will not pass to the permittee until it has been paid for as herein prescribed.

4. No timber will be cupped except that on the area designated by a Forest Officer; and no marked tree or trees under the diameter limits will be cupped or chipped under any consideration.

5. No tree____________ inches or less in diameter will be cupped ; not more than one cup will be placed on trees from __________ to____________inches inclusive in diameter ; not more than two cups will be placed on trees from ____________ inches to______________inches inclusive in diameter, and not more than three cups will be placed on any tree. All diameter measurements are to be taken at a point two and one-half feet above the ground.

6. So far as possible, the depth of all streaks will average one-half inch or less, and in no case will the depth of streaks exceed three-fourths of an inch not including bark. The width of the streaks will be so regulated that no more than one-half inch of new wood will be taken from the upper side with each streak and so that the total height of the faces shall not exceed fifty inches during the life of this Permit. Bars or strips of bark no less than four inches wide in the narrowest place will be left between faces, and the edges of faces will be parallel with each other and be placed vertically up the tree. So far as possible, where more than one face is placed on a tree, one bar between them will not exceed six inches in width. No more than one streak will be placed on any face during any one week. The chipping will be uniform in depth from shoulder to peak. Faces not chipped in accordance with these specifications may be marked out and the cups removed by the Forest Officer.

7. One of the modern cupping systems will be used, and the cups and aprons or gutters will be so placed that the shoulders of the first streak will not be more than ____________ inches distant from the bottom of the cup, and the cups will be placed as near the ground as possible. No wood will be exposed on any tree by removing the bark below the gutter or aprons.

8. No unnecessary damage will be done to cupped trees, marked trees, or to trees below the diameter limit. Trees that are badly damaged during the life of this Permit, when such damage is due to carelessness or negligence on the part of the permittee, shall be paid for at the rate of $5 per 1,000 feet B. M., full scale, and the Forest Supervisor shall decide as to the presence and extent of damage.

9. No cups will be placed later than ______________ 191____ without written permission from the Forest Supervisor, and all timber embraced in this Permit will be cupped before said date.

10. Unless extension of time is granted, all timber will be cupped, chipped, dipped, scraped; the product and all cups, aprons, gutters and nails removed and each cupped tree thoroughly raked

to the satisfaction of the Forest Officer, on or before and not later than ____________________ 191 ___

11. No fires shall be set to the timber, underbrush or grass on the area included in this Permit without the written permission of the Forest Supervisor, and every effort will be made by___ , __ employees ; sub-contractors and employees of sub-contractors, to prevent the burning over of said area from any unauthorised cause ; and during the time that this Permit remains in force and effect________ and all________ *employees, sub-contractors, and* employees of sub-contractors, without any charge whatsoever to the Forest Service, will do all in our power both independently and on request of Forest Officers to prevent and suppress unauthorised forest fires.

12. All cupped trees will be raked in a workman like manner for the space of 2½ feet around each tree before January 1st of each year of the life of this Permit ; and a fire-line not less than three feet wide in the narrowest place shall be hoed or plowed around the area covered by this Permit in such a manner as to completely isolate it from adjoining lands. Natural fire brakes, such as creeks, swamps, roads, etc., may be utilised with the consent of the Forest Officer. These fire-lines must be made and receive the approval of the Forest Officer before any cups are placed the first year or new streaks made at the beginning of the second and third years.

13. Special Use Permits will be obtained for such cabins, shelters, camps, telephone lines, etc., as may be required on Government land in carrying out the terms of this Permit.

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The decision of the District Forester shall be final in the interpretation of the regulations governing this Permit.

Work may be suspended by the Forest Supervisor if the regulations contained in this Permit are disregarded, and the violation of any one of said regulations, if persisted in, shall be sufficient cause for the District Forester to revoke this Permit and to cancel all other permits for other privileges.

"No member of or delegate to Congress, or Resident Commissioner, after his election or appointment, and either before or after he has qualified and during his continuance in office, and no officer, agent, or employee of the Government shall be admitted to any share or part of this contract or agreement, or to any benefit to arise thereupon. Nothing, however, herein contained shall be construed to extend to any incorporated company, where such permit or agreement is made for the general benefit of such incorporation or company. (Section 3741 R. S. and Sections 114-116, Act of March 4th, 1909.")

No person undergoing a sentence of imprisonment at hard labor can be employed in carrying out the terms of this Permit. (See Executive Order of May 18th, 1905.)

Refund of deposits under this Permit will be made only at the discretion of the District Forester, except when the amount of such deposits is more than the total amount required under this Permit.

This Permit is non-assignable. (See Section 3737, Revised Statutes of the United States.)

The conditions of this Permit are completely set forth herein, and none of its terms can be varied or modified except with the written consent of the Forest Supervisor. No subordinate Forest Officer has, or will be given authority for this purpose. If required as a guarantee of a faithful performance of the conditions of this Permit ________ will submit a bond in the sum of________________ ($________) dollars, which bond, together with all moneys paid or promised under this contract, upon failure on____________part to fulfil all and singular the conditions and requirements herein set forth, or made a part thereof, shall become the property of the United States as liquidated damages and not as penalty.

Signed in duplicate this ________ day of ________________ 191——

WITNESSES :

________________________[SEAL.]

Name of Company.

________________________[SEAL.]

Name of Officer Signing.

____________________ ________________________

Title of Officer Signing.

APPROVED and Permit granted under the above conditions on this________ day of __________ 191 ___

____

Name

____

Title

ANIMALS IN SICKNESS.

It is not easy to watch the larger animals when these are stricken by disease; or when an animal in a state of nature finds itself unable to carry on its usual life, it retires into the depths of the forest, or to some hiding place and dies unattended and alone. Sympathy from those of its own kind it cannot expect, for life is too much of a struggle to admit of much kindness being shown by one creature to another, though instances have been known where some kind feeling has been displayed as in the case of a wounded elephant, whose companion aided its escape; but in most of such cases the animals have been brought into contact with man, for in a natural state it is rare.

At the present time, when most civilised nations are producing even greater numbers of degenerates, that is, those unfit either in body or mind, or both, to benefit the race, it may be that we may learn something from the lower creatures as to how they keep up their high standard of health; for it is a remarkable thing that wild animals conform to every known rule of health and have practised such rules from times unknown.

Though wild animals know instinctively that "prevention is better than cure," there are several remedies known to some of them in case of sickness, provided this is not infectious. When an epidemic breaks out among them they seem powerless to avert ruin, and whole districts are decimated by such a disease as the terrible rinderpest, which a few years ago deprived large districts of Africa of almost all wild game. This disease is almost exactly similar to anthrax, and acts in the same way; possibly, therefore, it was introduced by man, and may have begun its ravages by being imported into Africa with some domestic breed of animal. Indeed, it is not unlikely that most of the epidemics among wild animals may have come to them from man in some form or another.

Animals will do anything to keep themselves in perfect condition, and they have learned in the course of ages that cleanliness is one of the conditions of health. It is wonderful what care all creatures will take to keep themselves and their dwellings clean, and a bird's nest even when the parents are most

busy feeding their ravenous young ones is usually beautifully clean. The care they will take of their skins and coats, or in the case of birds of their plumage, is wonderful.

Many ages before mud-baths came into fashion among humans, the curative value of mud was known to many animals, and animals in tropical countries frequently take mud-baths; indeed, wounded elephants and other large quadrupeds will roll themselves in the mud of a river-bank and will fill up the wound with mud if they possibly can, while wounded birds will sometimes also fill up a wound to prevent foreign matter getting into the wound, which they seem to know from experience will do mischief.

Luckily perhaps for themselves, the vast number of drugs and medicines wherewith poor humanity is dosed are unknown; but there are several plants which animals use as medicine, and it has even been said that we have learned the value of some such by watching the use made of them by animals and birds. Thus it has been told that the healing value of the springs of Bath became known by watching a sick pig which drank the water; and though we no longer believe that snakes rub their eyes with fennel to improve their eyesight, yet certain plants are certainly eaten by animals to produce certain results. Thus in tropical countries capsicums are eaten by various birds when these feel they need a stimulant, while in our colder climates the wild arum and other plants with biting flavours are eaten for the same reason. Mammals, too, will eat grass, the sharp blades of the sword-grass being in demand among dogs and cats when they require an emetic; while grass-eaters will travel long distances to procure salt; indeed, their extreme desire for salt has been the means of bringing many of them to destruction, for hunters take up their position near the "salt-licks" in the same way as they do near the drinking places in hot countries.

Digestion is a thing carefully looked after by wild creatures; they seem to know how important it is to their life that this should be kept in perfect order. Thus dogs and cats will eat ashes now and then, and birds and even snakes will swallow stones to aid digestive powers. When hens are laying, of course, they require

lime to form the shells, and the amount of grit and fragments of stone they then eat is incredible; if they have been confined in a small place for some time and suddenly turned loose upon a heap of gravel or where they can obtain small stones and grit, they will be seen devouring them as if the heap had been formed of corn.

When the last stage comes as it must come to all things, wild or tame, the end is usually merciful in its speed. To die a violent death is the fate of most wild animals, and surely this is preferable to the wasting plague or slow decay which awaits so many of us, added to which they have not the anticipation of evil we possess, and which is the worst part of suffering. Now and then one of them may linger on into old age, but as a rule, when a wild thing can no longer maintain its high standard of activity, it perishes at once. When the last hour comes it will separate itself from its fellows and get into the most private place it can find, so that it is seldom anyone has watched a wild animal die. It seems that the first requirement of a stricken animal is to be at peace from friends and foes alike.—[*Globe.*]

BRITISH FORESTRY.

The Right Hon. Walter Runciman, M. P., President of the Board of Agriculture and Fisheries, has appointed a committee to advise the Board on matters relating to the development of forestry. References will be made to the committee from time to time as occasion arises. The committee will be asked in the first instance (1) to consider and advise upon proposals for a forestry survey; (2) to draw up plans for experiments in sylviculture and to report upon questions relating to the selection and laying out of forestal demonstration areas; (3) to advise as to the provision required for the instruction of woodmen.

The committee is constituted as follows: Sir Stafford Howard, K. C. B. (chairman), Mr. F. D. Williams-Drummond, Sir S. Eardley-Wilmot, K.C.I.E., the Right Hon. R. C. Munro-Ferguson, M.P., Lieut.-Col. D. Prain, C.M.G., C.I.E., F.R.S., Mr. E. R. Pratt, president of the Royal English Arboricultural Society; Professor Sir W. Schlich, K.C.I.E., F.R.S., Professor Wm. Somerville, D.Sc.,

the Hon. Arthur L. Stanley, Mr. R. L. Robinson, of the Board of Agriculture and Fisheries will act as secretary.

As announced in reply to a question asked in the House of Commons on Tuesday, February 20th, Sir E. Stafford Howard has tendered his resignation of the office of one of the commissioners of His Majesty's Woods and Forests. His resignation will take effect as from March 31st next. No new appointment of a Commissioner will be made to fill the office he vacates, and there will be a fresh allocation of the Commissioners' duties between the two remaining Commissioners, Mr. Runciman, the President of the Board of Agriculture and Fisheries, and Mr. G. G. Leveson-Gower. The supervision of the Crown forests other than Windsor and of the more important Crown woods will now be committed to Mr. Runciman, with the object of bringing their administration into closer co-operation than has hitherto been possible with the work of the Board in regard to the development of sylviculture and forestry.—[*The Field.*]

WOOD FLOUR.

The United States Consul at Christiania, Norway, has given in his report some uses to which wood flour is now put. The flour is ground in a cheap mill, very similar to those which grind corn and rye. Pine and spruce sawdust is used in Europe, and after passing through the stones and the bolting chest, it is sacked or baled for shipment. It is then worth £2 8*s*. to £2 12*s*. a ton.

The flour has a number of uses. It is the absorbent for nitro-glycerine, which is the explosive ingredient. Wood flour dynamite is inferior to that made with infusorial earth as the absorbent; but it serves many purposes, and is cheaper. But dynamite is one of the smallest prospective uses for the product. Linoleum makers mix it with linseed oil, and give body to their flour coverings. It is not considered quite equal to ground cork for this purpose, as it is less elastic; but it is cheaper, and meets requirements for medium grades.

The flour fills an important place in the manufacture of xyolite, a kind of artificial flooring, resembling wood in weight, and stone

in other respects. It is used for kitchen floors, and in halls, corridors, cafés, restaurants, and public rooms. It is impervious to water, and is practically fireproof. It is floor material in some of the German war vessels. It is so used because it is not liable to take fire or splinter if struck by shells.—[*Timber Trades Journal.*]

MEDICATED SAW-DUST.

Medicated saw-dust is prepared thus :—A sackful of pine-wood saw-dust, coarsely sieved, is medicated with the following mixture :—Two buckets of water charged with oil of tar, 2 pints; mercuric chloride, 60 grains ; ammonium chloride, 60 grains:—*Brid. Mod. Journ.*, December 30th, 1911, 1720.—[*Pharmaceutical Journal.*]

BAMBOO HATS: A GROWING INDUSTRY.

A growing industry and one that promises to experience a steady growth in the future is the manufacture and export of bamboo hats, which has received a remarkable impetus since that passage of the Payne-Aldrich Bill providing for the free admission of these hats into the United States.

The following article on bamboo hats is taken from "Reciprocity and the Philippines," published by Mr. Harold M. Pitt :—

Among the lesser industries of the Islands is the manufacture and export of hats made of bamboo. This is an industry that is carried on in the homes of the natives of certain sections of the islands, and the work is all done by hand.

France is the best customer for these hats, and in 1909 took 227,603, valued at $73,327 out of a total exported of 440,842 valued at $142,480. The Payne-Aldrich Bill provided for the free admission of Philippine products into the United States, and opened up a new market there for these hats, and in 1910 there were exported to that country 176,938, where in the preceding year there had been but 12,169. The total exports in 1910 increased to 600,486 hats, value $276,309.

As the hats are very favourably received wherever introduced and are comparatively cheap, the industry is one that will

probably experience a steady growth. The material for their manufacture is found in almost every section, and as the demand increases the industry will doubtless be more generally introduced among the people, thus adding in a substantial way to their earning capacity The making of these hats does not interfere in any way with the agricultural pursuits of those who are engaged in the work, as the women and children devote their spare time to it.—[*Manilla Bulletin. Indian Agriculturist.*]

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FOREST LOANS.

It has more than once struck us that Local Governments and Administrations are not always obtaining the revenue that they have a legitimate right to expect from their forests, the reason being twofold, first in that they meet all capital expenditure that has to be incurred out of revenue, and secondly that a considerable share of the profits goes to the middleman. It is open to question whether the methods employed of working and improving the forests, in other words, the broad lines on which our forest policy is based, are justified from a financial point of view, as being the best possible in the interests of the owner. It would not be considered businesslike on the part of a commercial company to be continually devoting a large portion of its earned income to capital expenditure thus benefiting the shareholders of the future at the expense of those of the present.

It is not difficult to imagine the outcry that would be raised if railways, steamship companies, land trusts, jute mills and other commercial undertakings, instead of paying their shareholders the dividends that they had the right to expect, threw a large part of

the profits into the concern, thus increasing its capital value for the benefit of the shareholder of the future, and yet this is what the Forest Department is doing every day. If any firm or corporate body finds it expedient to raise additional capital so as to permit of improvement in, or expansion of, working with the object of paying increased dividends, how does it proceed? We have only to look at the commercial or financial columns of the newspapers and we see that for such purposes borrowings are continually being resorted to. The methods of floating and paying off such loans may differ, but the underlying principle, *i.e.*, the raising of working capital by means of loans remains the same. Thus to improve a harbour a port trust loan is advertised, to render a desert fertile an irrigation loan is placed on the market, while large commercial companies raise loans under the name of debentures, thus making those who are to reap the benefits of the designed improvements pay their fair share towards them. The duration of these loans is various, they may be perpetual, repayable in a fixed number of years, from a sinking fund, or gradually by means of drawings—this is a detail. We represent a *quasi* commercial department, and on the analogy of what is daily taking place in the commercial world, we should like to see the principle of forest loans scrutinised with a view to its acceptance. We can see no reason why Local Governments should not be authorised to raise such loans for the creation, permanent improvement and development of forests and forest industries. We admit that up to the present we can quote no precedent, but on the other hand can see nothing against the adoption of the proposal. Working on loans the administration of the present would derive a larger income and legitimately so, resulting no doubt in the income of the future being smaller, since the future as well as the present would have to pay interest charges as also its fair share towards the fund for the redemption of the borrowings that may be necessary. In the event of the principle of forest loans being accepted by the Government of India, it is perhaps not unreasonable to hope that they would themselves lend the money at a low rate of interest. If this were not agreed to then we see no reason why the loan should not be placed on the

open market secured on the forest or general revenues of the province.

Such loans might take the form of short term borrowings for a particular object or they might extend over considerable periods, as the case might be. The object of a short period loan would, we imagine, usually be the opening up of a comparatively small, though well defined forest tract, at present inaccessible or whence the existing difficulties and rates of transport render the sale of produce unprofitable, a good example being the construction of a tramway or some other method of mechanical transport as a means of export, or a large sawmill to convert timber in some particular forest whence in its unconverted state its extraction is not feasible—or again, a short period loan might well be issued for the experimental establishment of some forest industry under the guidance of an expert on a commercial scale, with a view to it being placed upon the market once its money earning capacity had been proved, and with the object of encouraging similar enterprises. We would instance an experimental rubber plantation, a factory for manufacturing tannin extracts, plant on a commercial scale for the manufacture of saleable by-products by destructive distillation of wood, etc. In all these instances repayment of the loan would naturally be made on the disposal of the undertaking. Long period loans might well find their justification in the creation, extension, permanent improvement and actual continuous exploitation or development of large forest tracts, as also in the establishment of some forest industry on a large scale that the Department for special reasons intended to keep in its own hands, *e.g.*, the manufacture of turpentine and colophony.

To enlarge on this point—what naturally suggests itself as a good example in connection with long period loans for the creation and extension of forests is the creation of irrigated plantations or the extension of existing ones for the supply of small timber and fuel to the countryside, there being this further indirect benefit that by a supply of fuel at a cheap rate, the cowdung so often substituted for it will be available for use as manure whereby the agricultural value of the land will be

enhanced. The Punjab furnishes instances of what can be done in this direction. Should water not be available, plantation projects might still be indicated in some localities from which to draw, in addition to a supply of fuel, material for some special industry, such as bark for tannin extracts. No doubt other instances will suggest themselves to our readers. Passing to the betterment of our forests large sums are annually spent out of revenue on various cultural improvements which often yield no direct and early return, though they undoubtedly increase the capital value of the forest estate. Such improvements might well be carried out on a greatly extended scale were capital, to pay for supervision and labour, available. Loans for this purpose would not perhaps appeal to Local Governments to the same extent as loans for schemes expected to yield an early return, but they would, we consider, be justified from a sylvicultural point of view. Burma would seem to offer a wide field. Loans for the exploitation and development of a forest tract on a large scale would be more attractive. In Burma again, for example, there are large areas of "Pynkado" and "In," at present awaiting the lumberman, the working out of which, not now undertaken for want of transport facilities which are expensive, of establishment to supervise and of labour, might well be spread over a long period, and which, looking to the increasing demand for sleepers and building timber, must prove of service to the industries and enterprises of the country. Another instance presents itself to us in Assam where somewhat recently forest tramways have been initiated on a small scale to tap comparatively limited areas where otherwise the trees would often have been left to deteriorate and perish. In that province there must still be immense tracts untouched, to extract the produce from which will be required considerable initial outlay such as the Local Government would find it difficult to meet from revenue, even if this course were justifiable, *e.g.*, perhaps the Nambar forests. Again the North Andamans island possesses virgin forest in which padauk is the principal species of value. Once the demand for this timber is assured, there can be little doubt that a long period loan on a large scale to admit of it being worked

continuously over a sequence of years would be a commercial proposition worthy of the most careful scrutiny.

What is required is a series of well thought out projects for the extraction of timber on a considerable scale from difficult localities and for the experimental establishment of forest industries under expert management on a commercial basis, involving perhaps the appointment of a Forest Engineer to work in co-operation with a Forest Officer placed on special duty, to formulate any likely schemes. On such schemes being approved there seems to be good cause to bring them into being by means of Forest Loans.

At the beginning of this article we noted that revenue was being lost by allowing a considerable share of the profits of working to go to the middleman. This indicates in certain cases the expediency of direct departmental working. There can be little doubt that in some provinces a very considerable income is being foregone by working through middlemen or contractors. The Burma net forest revenue is, we believe, some 66 lakhs of rupees. We have heard it stated on excellent authority that it would considerably exceed 80 lakhs of rupees at a moderate estimate, if recourse were to be had to departmental working. Is any Government justified in giving away this large difference to the middleman? We think not. The objection will no doubt be raised that with the existing staff any extension of departmental working is not possible. We grant this, but why should not the staff be increased and facilities improved? Men are available, elephants can be procured, while mechanical means of transport are not unknown. We admit at once that our existing staff is wholly inadequate and would have to be strengthened and placed on a par with what would be kept up by commercial firms, it is probably inadequate for the departmental working that we actually undertake, let alone any extension of this: to illustrate our meaning we would ask our readers to compare the staff that the Bombay Burma Company maintains when working out a forest, mostly men of high education and ability, with what we are able to provide under similar circumstances. One is working on

commercial lines while the other has not even the means of doing this, if it wished to. Or to take a second example showing how we have worked a forest industry and how a Company works it. It is, we believe, a fact that when the South Burma rubber plantation was worked direct by the Department, our controlling staff consisted of one Extra Assistant Conservator; we are informed on very good authority that since its sale to a Company there are no less than six Europeans connected with its working and possibly more, it is improbable that employment is given to these men out of pure philanthropy. Thus it is self-evident that the Department cannot undertake departmental work on a large scale without putting down considerable capital for staff, means of transport and for various contingent expenditure. To raise this capital we hold that loans would be amply justified. If the working were continuous, *i.e.*, moved yearly or periodically from forest to forest, the extra establishment required would be kept on, and its members would become adepts at their work. They would form the Executive Commercial Forest Staff (and as an incentive to good work might well be given a percentage on the profit), quite distinct from the professionally trained staff which would consist of officers technically educated in Europe or India as now existing, paid perhaps on a relatively higher scale, and who would form the sylvicultural or scientific branch of the Department. In order to work on the lines suggested the working-plans of the various forests would very probably require modification, one comprehensive working circle would replace several small ones, and perhaps one plan embracing a large area of country would have to be substituted for several of the existing ones with a view to the concentration of work, this rendering supervision easier and extraction cheaper.

In making the above suggestions we must not be taken to advocate departmental working in every case. In many parts of India there would be no advantage or profit in eliminating the middlemen or contractors, who often exist in considerable numbers, a fact which in itself is a guarantee of fair competition and of good prices being obtained. Each of these contractors has often the

command of a small labour force and of a limited transport, he knows the various local centres of consumption where the demand very possibly varies from year to year being at no time perhaps very considerable, and is in a far better position to supply and handle these than the Forest Officer. Here the middleman meets a real want and deserves every encouragement.

The question of Forest Loans is one of considerable magnitude and much both for and against no doubt remains to be said, quite beyond the scope of a short article. We should like to see the subject well ventilated in our pages and will welcome correspondence. We should still more like to see a Local Government in the interests of its forest development place a concrete case before the Government of India which would then have occasion to review the policy that we have rightly or wrongly for long accepted, namely that capital charges must be met out of income, and that the further improvement and development of the forest estate must depend on the extent that the necessary funds can be made available from the forest revenue of the province.

POSSIBLE MARKETS FOR CERTAIN FOREST PRODUCTS.

The difficulty of bringing the producer in touch with possible consumers of forest products, for which there is not at present a recognised market, is often a difficult business. This is not surprising as often the Forest Officer, who is in this case the producer, cannot get into direct touch with possible purchasers, who may live far away from the area from which the produce in which they are interested is obtainable.

Another difficulty is experienced in this connection, which arises after a possible purchaser has been put in touch with the local Forest Officer. Owing to the Forest Department's obvious inability to store any timber or minor product for which there is not a regular demand, an enquiry made by a firm for a certain product cannot be complied with promptly, so that the question of supplying the material for which an indent has been made often

falls to the ground and not infrequently the prospects of a very useful business for the above reason come to nothing.

It is by no means easy to overcome this difficulty, except possibly in the case of valuable timbers for which there is only an irregular market, but which can be stored in seasoning sheds and be supplied as demand arises.

The question of putting the officers of the Forest Department in touch with possible purchasers can in a measure be overcome, especially when firms or private persons make enquiries of the Conservators, by their forwarding such indents to their Divisional Officers for disposal or when the enquiry is made of Inspector-General of Forests or of the President of the Forest Research Institute by their taking the necessary steps to inform the local Forest Officers in whose forests the timber or minor product grows of the enquiry having been made.

Another way of dealing with the question is to keep the Department and the commercial world informed of the new uses found for the various timbers or minor forest products for which there may or may not be purchasers, but which in any case have been found to be of use for certain purposes.

It is proposed to give below a few details concerning a limited number of forest products about which enquiries have lately been made and which it is hoped may possibly lead to the disposal of forest products for which there is at present little or no demand.

I.—TIMBERS FOR RAILWAY CARRIAGES AND TRUCKS.

The inside fittings of 1st class railway carriages in India are generally made of either teak or of more ornamental woods, such as Bird's-eye maple or Australian silky oak for the panelling, with pillars and mouldings of blackwood, Andaman padauk, sissoo, etc., etc., or not infrequently foreign timbers. It is thought that certain Indian timbers could be used in the place of foreign timbers for panelling, such as satinwood, *Carallia integerrima*, *Gmelina arborea*, or even *Anogeissus latifolia* which when cut on a true radial section presents an extremely handsome wavy appearance.

Sample logs of satinwood and *Gmelina arborea* have recently been sent from the Central Provinces to the Superintendent of the Carriage and Waggon Department, Ajmer, R. M. Railway, to be given a trial in this respect. As the logs sent are still seasoning the results are not yet available.

The species of timber utilised for the mouldings, pillars and inside fittings of 1st class bogie carriages in India are not infrequently ornamental timbers chosen from the darker coloured woods in order to show up the lighter silver-grained panelling. Such species as sissoo, blackwood, Andaman padauk, walnut and teak are frequently used, as also ornamental foreign hardwoods. Timbers such as *Dalbergia Oliveri*, *Albizzia* spp., *Pterocarpus macrocarpus*, *Berrya Ammonilla*, *Terminalia bialata*, *Melanorrhœa usitata*, or any other fairly dark, ornamental timbers would probably be accepted by the Railway carriage builders who now have to pay high prices for foreign and the best ornamental Indian timbers to meet their requirements.

The tendency at present is to replace the old type wooden truck by trucks made entirely of iron. For ballast trucks, however, the bottoms of which are subject to so much wear and tear owing to loading and unloading of sharp edged broken ballast, wood is still largely utilised for the purpose. The timber employed in Northern India, and possibly elsewhere, is sal, a most suitable timber but yearly becoming more and more expensive for the purpose. It is probable that were other fairly durable and especially tough timbers brought forward for this purpose they would be readily accepted by the Railway authorities concerned. In this connection it is proposed to send sample logs of *Terminalia tomentosa*, *Lagerstrœmia microcarpa* and *Terminalia paniculata* to the R. M. Carriage Works for trial. There are many other timbers which deserve a trial in this connection such as *Terminalia myriocarpa*, *Lagerstrœmia Flos-Reginæ*, *Lagerstrœmia tomentosa*, *Careya arborea*, *Anogeissus latifolia*, *Schleichera trijuga* and a host of other hardwood species might be mentioned, provided they are fairly durable and especially tough, while the appearance of the timber and even its weight are of minor importance.

Any Forest Officers wishing to find markets for timbers which they cannot at present dispose of, and which they think might be suitable for any of the above-mentioned purposes, would do well, as a commencement, to send a few *really sound*, and if possible, seasoned logs for trial to the Superintendents of any of the large Railway Carriage and Waggon Works such as exist at Parel (G. I. P. Railway), Ajmer (R. M. Railway), Lilloah (E. I. Railway), Insein (Burma Railway), Lahore (N.-W. Railway), Lucknow (O. and R. Railway), Madras (M. and S. M. Railway), Kharagpur (B. N. Railway), Kanchrapara (E. B. S. Railway), etc.

II.—TIMBERS USEFUL FOR TOOL AND MALLET HANDLES.

Some specimens of timber were recently sent to the Jamalpur Works of the East Indian Railway to be tested for mallet and tool handles. Up to that time ash handles were imported from Europe for the purpose at very stiff prices. Amongst the species of timber sent for trial were specimens of *Anogeissus latifolia Gmelina arborea* and *Lagerstrœmia parviflora*. All were passed as suitable for the purpose, but the Workshops prefer the former about which they give the following report :—"It gives equally good results with English wood and has so far exhibited no defects for the purpose named."

The amount of timber required for such a purpose might at first sight appear to be insignificant; on the other hand, it must be remembered that from 20,000 to 25,000 tool handles are required annually by large workshops such as exist at Jamalpur, of which at least 8,000—10,000 handles are up to 3 ft. in length, namely those used for sledge hammers, and fire and coal-shovel handles. To shape such handles with flange-head and handle from one piece of wood requires a block about $5'' \times 5'' \times 36''$ in size or roughly $\frac{1}{2}$ c. ft. timber, so that the amount required to produce 10,000 handles would be 5,000 c. ft. of sawn material for the larger handles only.

It appears reasonable to expect that similar Railway Works or other places such as coal mines, etc., in which large numbers of tool handles are annually required would also be willing to utilise

the above-mentioned species of timber for such purposes, were the case properly put before them and the necessary facilities given them in order that they might first test the timbers.

III.—PENCIL WOODS.

A variety of timbers have recently been tested for pencil-making in India of which none can be said to be ideal for the purpose. Probably the best timber for the purpose, so far as is known, is *Juniperus macropoda*, next in order of utility to this species comes *Cupressus torulosa* which makes up into a fair to good pencil. *Podocarpus neriifolia, Cedrus Deodara, Wrightia tomentosa, Pinus excelsa* and *Pinus longifolia* have all been passed as suitable for pencil making but are all somewhat tough for the purpose.

A cubic foot of wood can be made up into about two gross of pencils and the price that can be paid at the factory for the most suitable classes of timbers which make up into the better class of pencils is from 12 to 14 annas per c. ft. in fair-sized logs and 6 to 8 annas per c. ft. for small billets.

To run a moderate-sized factory 18,000 c. ft. of timber are required annually. There exist at present a few small to moderate sized pencil factories in India, such as the Small Industries Development Factory at Tollygunge, the Bengal Pencil Factory both near Calcutta and the Gujerat Pencil Factory, Broach District, Bombay Presidency ; while one is reported to be starting in Dharwar and the erection of several others is contemplated.

IV.—MELANORRHŒA USITATA OR THITSI DAMMAR.

The result of Mr. Puran Singh's note, published in Vol. I, Part IV of the Indian Forest Records, on this subject has resulted in no less than twenty-six enquiries being made within a few months from Europe for this product. The difficulty in bringing these enquiries to a satisfactory conclusion has been in finding agents in Burma who deal in this commodity. Were any firm found who would be willing to stock *Thitsi* dammar there appears every reason to believe that enquirers would be forthcoming to purchase this natural varnish.

Complete data as to outturn are not to hand, though fairly large quantities are known to be available from the Katha Division in Burma. Mr. Blandford, the Deputy Conservator of that Division, has submitted a most interesting report on the subject, in which he gives the rough estimate of the possible outturn as 13,500 viss per annum (1 viss = 3·6 lbs.). The actual amount of 'Thitsi' which came into Mandalay in 1909-10 was 1,077 viss, but this figure is considerably below the total amount available.

V.—OIL-SEEDS.

The enquiry as to the possibility of utilising certain oil-seeds obtained from trees growing in the forest has been going on for several years. It is by no means an easy matter to bring such enquiries to a successful termination, though there now appears to be a fair prospect of obtaining definite results with a few species of oil-yielding seeds.

The only oil-seed which is at present exploited from the forests in commercial quantities is that of *Bassia latifolia.* There are, however, several spice or drug-yielding seeds obtained from forests which are annually put on the market, while many seeds of other species are collected for the oil they yield, but their use is generally limited to the local requirements of the agricultural population living in the vicinity of the forests from which they are obtained.

The difficulties usually experienced when attempts are made to exploit oil-seeds from the forest are—that the collection is expensive, owing to the scattered distribution of the species from which the seed is collected; that the Forest Officers cannot find time to carry out the work departmentally, so that local contractors have to be employed who are not infrequently unwilling to take up a new business of this nature, and that the possible purchasers lay down terms, such as the expression of the oil on the spot or the decortication of the husk, which cannot be complied with by the local contractor. Another condition which is generally necessary before an oil-seed can be exploited commercially is that a very large annual supply of seed is necessary—a condition

which can only be fulfilled by very few species growing in our forests.

The question of placing the seed of *Schleichera trijuga* on the market has received considerable attention lately, as the oil obtained from the 'Kossum' seed has been tested for soap-making by the North-West Soap Factory, Meerut, and found most suitable for the purpose, while Smith Stanistreet & Co., Calcutta, have indented for 500 maunds a month of this seed, which it is understood they require for the preparation of glycerine.

Samples of this oil were expressed by the Forest Chemist who found the ratio of the kernels to husks as 1 to 1·17, and the percentage of oil in the seed to be 56 per cent on the total weight of the seed or 25 per cent by weight of the kernel. These results were obtained by expressing the oil in a small hand hydraulic press; had the oil been expressed in a large hydraulic press working on commercial lines and the seed been treated in a hot state the percentage of oil obtained would have been higher. The latter statement is based on a chemical analysis carried out by Dr. Walter Leather, at Pusa, with seed submitted to him for trial in which he found 64·73 per cent. of oil present in the kernels. To form an idea of the amount of oil obtainable from oil-yielding seeds, it may be stated that in an up-to-date hydraulic press, treating the seed hot, within 12 per cent of oil in the seed can be expressed.

The oil-cake obtained by expressing the oil from the Kossum seed was sent to Pusa for report and passed as suitable for feeding cattle and also for manurial purposes. Kossum is a very common tree in certain forests of the Central Provinces, in the drier parts of the Bombay Presidency and also in some forests of the United Provinces, so that there appears to be a good opening for this oil provided an enterprising Forest Officer wishes to push such minor produce. To do so it would be necessary to work out figures of outturn and cost of landing the seed f. o. r., and then to consider whether it would be best to export the seed to the market or express the oil on the spot. To carry out such work departmentally is in most cases not possible, so that a local contractor would either have to be employed by the Department to collect the seed

and land it on a line of export or the contractor would have to be put in direct touch with possible purchasers, and carry out the work at his own responsibility. The price which purchasers can afford to pay for the oil cannot be stated with certainty, though were a Forest Officer to consider the possibility of working out the seed, such figures would be available on application being made to the President of the Forest Research Institute and College, Dehra Dun.

Another seed which promises to be of interest to the commercial world is that of *Mesua ferrea*, or Nahor, which is found to grow abundantly in the Assam Valley. This species has the advantage over the 'Kossum' in that the seed is large and heavy and therefore requires fewer seeds to make up a unit of weight, while Nahor grows far more gregariously than is the case with the Kossum tree, thus greatly facilitating the collection of the seed. Again the percentage of oil yielded by the Nahor seed is even higher than that from Kossum seed, having been found to contain, by the Reporter on Economic Products, as much as 72·9 per cent of oil in the kernel, as against 64·73 per cent in the case of 'Kossum.'

The oil obtained from the Nahor seed is of a yellow to red-brown colour. Samples of the oil have been sent to several firms for report, and though no answers have as yet been received, it is thought that the oil will be found suitable for soap-making and also possibly for the preparation of glycerine.

Large quantities of this seed are obtainable from the Lakhimpur and Sibsagar Divisions in Assam, as also from elsewhere. Were Forest Officers desirous of having a commercial test carried out by expressing the oil in a powerful hydraulic press, it is thought that such a trial could be arranged for in one of the large oil-mills in Bengal.

Enquiries have been made in recent years for the seed of *Hydnocarpus Wightiana* and *Taraktogenos Kurzii*, the oil obtained from which is said to be in request in England as a cure for leprosy. Any Forest Officer in whose forests these species occur and who wishes to find a market for these seeds would probably do so either by addressing any of the wholesale Chemists in Calcutta,

Madras, Bombay or other large trade centres or by informing the President of the Forest Research Institute to whom enquiries of this nature are generally addressed by wholesale Chemists.

VI.—CANES.

Canes are much in request all over the world for a variety of purposes, such as furniture work, drag ropes, sporting requisites, basket-making, fishing-rods, walking-sticks, umbrella-handles, etc., and though large quantities are extracted annually from certain Forest Divisions to meet this demand, it is thought that as the possible supply is in many cases far in excess of the present demand, a further development of the trade might well be encouraged.

The difficulties which present themselves in this case are similar to those which arise when attempts are made to put any other minor product on the market, namely, the difficulty in putting the possible consumer in touch with a local agent or contractor who would be willing to exploit the canes. In localities where canes are already exploited in considerable numbers, there must necessarily be persons who carry on their business, but in places where canes are not exploited for the market the difficulty of getting a man to take up such work is not infrequently nearly impossible.

The best chance of increasing the demand appears to be by supplying, in the first instance, samples of canes to any enquirers free of cost and on a definite offer being made by such persons to try and induce a local contractor to take the business in hand, by giving him the first year's outturn free or at a nominal cost.

As instances of inquiries made for canes, it may be stated that the Basel Mission, Cannanore, Madras, are making attempts to obtain supplies of canes from Bengal and Assam, though whether they have found what they want is not known. A firm in Sialkot, manufacturing sporting requisites, are making similar enquiries, while Messrs. Fernandez and Rovirosa of New York are making enquiries for canes for furniture making.

In conclusion it may be stated that every attempt will be made by the Forest Research Institute to put consumers in touch with

suppliers, or attempts made to find new uses for forest products on application being made in this connection ; on the other hand, it cannot be guaranteed that such attempts will always be successful as the difficulties of carrying such enquiries to a successful conclusion are manifold as has been pointed out elsewhere in this note.

R. S. PEARSON, I.F.S.,
Forest Economist.

15*th April* 1912.

ON THE UTILIZATION OF FIRE-LINES.

Not so very long ago a controversy existed on the respective merits of the two classes of fire-lines respectively known as 'Open' and 'Covered' or in some places as 'Pucca' and 'Katcha.' Forest Officers are aware that the difference lay in the 'Open' fire-lines being cleared of all trees, while in 'Covered' fire-lines only the small trees, shrubs, herbs and dry leaves were burnt. The 'Open' or 'Pucca' fire-lines have so completely won the day, that in many districts no other kind of fire-line is known. There is little doubt that where we are dealing with forests, like the majority of those in India, which consist of trees shedding their leaves during the very time of the year when it is most important to keep the lines clean, covered fire-lines are difficult to maintain. Not only this, but the shade of the trees is usually not sufficiently dense to suppress grass, the annual firing favours the growth of the grass, and the overhead shade impedes its drying, so that it will not burn before the adjoining forests are themselves in an inflammable condition.

Where we have large compact areas of forest with only a few lines running through them the loss of area from such fire-lines is comparatively insignificant. But the loss of area becomes a very serious matter where fire-protection has reached a high grade of intensity, and this is especially the case in forests with good and deep soil which grow, or are capable of growing, a valuable crop. There must be a limit to which we can cut up forests by fire-lines. Up to a certain point we are justified in

increasing and widening our lines in valuable forests and cutting it up into far smaller areas than in poor forests. In the latter the expenditure on fire-protection may not justify us in isolating blocks by fire-lines of possibly less than ten square miles in area, the limit laid down by Mr. Dansey in some Bengal forests. In other more valuable forests, so far as the proportion of expenditure to the total assets from a fire-protected crop is concerned, we are justified in isolating by means of internal fire-lines and fire-traced roads, very much smaller areas. But in such cases the area of land thrown out of production soon becomes important. In many cases I have found forests of little immediate present value cut up by lines, open fire-lines or fire-traced roads, into areas of only four square miles or less. This is evidently not justifiable as the expenditure on fire-protection eats up the whole of the profits.

It does not seem to be realised that every area of four square miles isolated by fire-lines 100 feet wide means a loss of close on 100 acres (96·7 acres). In small forests of only three or four square miles in extent where all boundaries have been cleared to 100 feet wide and perhaps a wide fire-traced road runs through the middle, the loss of area may be equivalent to a whole year's coupe of the working circle of which it forms a part.

There are other important objections to numerous open fire-lines and roads with open fire traces. These lines are frequently run along either side of a stream causing the drying up of the latter. In the case of roads, oxen and bullock drivers and all concerned in the management of the forests or the extraction of the produce are fully exposed to the sun, a matter of no small consequence in the hot season.

I have no wish whatever to re-open the controversy of open and covered fire-lines, at least on the old lines. Experience has finally decided that in deciduous forests the open fire-lines are more serviceable to fire-protection than the *ordinary* covered lines. But the time has come to consider the utilization of the numerous fire-lines and fire-traces, ultimately to decrease the expenditure on them, and make them a source of comfort and profit instead of a dead load on the forest revenue. In nearly all our better and

more valuable forests trees which give a good shade and are evergreen' in the hot weather months can be grown with ease. Many of these trees are already ruthlessly felled along our cleared fire-lines especially in valley forests. The proposal is, then, to plant up the fire-lines with such trees, and especially such as are in themselves *valuable*. Many of them yield good timber, others fruits, and yet another the best kind of lac. Why should the fire-lines with good soil not be utilized for plantations of such trees? In many cases the Forest Department has lost much money on cultural operations scattered about in the forests on account, to a great extent, of their inaccessibility to supervision. The very location of some of these sowings and plantings is lost from the want of sufficient method in carrying them out and surveying them. But the locality of all fire-lines and fire-traces is well known, they are themselves lines of communication and daily patrol, the very presence of a labour force on them in digging holes for the young plants in the cold and hot weather would be useful, the clearing of the jungle threatening the young plants in the rains and cold weather would at the same time be the clearing of the fire-line, the dense shade of the old trees would effectually prevent the growth of any grass, no leaves would fall during the hot weather, travelling along the shady forest roads and lines in the hot weather would be a pleasure, and finally the trees and their produce would form a valuable asset, especially in times of famine.

Critics will at once say that the picture may be nice, but the scheme impracticable, because such trees will not grow along most of our fire-lines and roads. But let them consider the success of roadside planting in dry dusty districts absolutely exposed to every hot blast that sweeps across the open country and where the leaves of the trees are daily covered with layers of dust. Compare those conditions with what we can give on fire-lines sheltered on each side by a wall of forest, often along valleys, and the plants always put in several deep to ensure mutual protection. Compare the conditions even with some of our own cultural operations, where watering is out of the question, and where deer and pig so often browse on the shoots, whereas the traffic along roads and

lines will reduce this last damage to a minimum. Finally, many of the trees that we would wish to plant already occur *naturally* in the very forests where the lines are to be planted. Indeed, for years it has grieved me to see fine Mango, Banyan and Jamun trees ruthlessly felled along such lines whereas what is required is an avenue consisting of them. In every district it would be easy to draw up a short list of the trees suitable for fire-lines and road traces. In the damper forests of India the selection would be very large. If we take the ordinary plains and low hill forests of India, the following trees at once suggest themselves. I would in all cases recommend the planting about 6 feet or 10 feet apart and thinnings would take place as necessary.

(1) The Kusum tree (*Schleichera trijuga*).—This tree sheds its leaves in quite the cold weather, but comes out again into brilliant red foliage at the beginning of the hot weather and gives perfect shade at the hottest time of the year. Planting has frequently been suggested on account of its lac-bearing properties alone. Its timber is excellent. Its fruit is edible and its kernel yields an oil. This oil has lately been under investigation by Mr. Pearson, the Imperial Forest Economist, and by Mr. Puran Singh, the Forest Chemist. The seed yielded 25 per cent of oil with a cold hydraulic press, and its value has been variously estimated at 8½ annas to Rs. 11-8-0 per maund *in situ*. For commercial purposes it appears to be valuable for soap-making, for glycerine, and for oil-cake. It is worth over Rs. 12-8-0 per maund in Calcutta. The cost of collection at present, however, from trees scattered all over the country is necessarily very large.

Apart from commercial uses, both the aril and the kernel of the seeds are eaten (the oil-cake contained 22·3 per cent. of proteids and 14·4 per cent of soluble carbo-hydrates), the oil is largely used for cooking purposes, and is used in the treatment of certain skin-diseases. It is also said to be a good hair-oil.

The tree is very readily grown from seed which should be sown as soon as ripe. The young plants are easily transplanted and I have had them 3 to 4 feet high in their second year.

It is not suitable for cotton soils. Its best position is along valley fire-lines, especially near nalas, but it will grow, if watered for the first year or two, in any locality within its distribution.

(2) *Mango.*—The mango is wild in many valleys over Central India and Bengal and, as is well known, is easily grown along road-sides. Its wood is valuable.

(3) Banyan (*Ficus bengalensis*)—As a shade tree it is unsurpassed while the fruits are eaten by people in times of famine, and very largely by animals and birds. It is easily grown from cuttings. It naturally does best in valleys but will grow almost anywhere. Another fig tree (*Ficus glomerata*) is also in full leaf in the hot weather and has edible fruits. Seedlings of figs can be raised by throwing the ripe seed among damp brick rubbish and keeping this moist.

(4) Toon (*Cedrela* spp.)—De Candolle in his monograph has described a large number of species of *Cedrela* and another, *C. Haslettii*, has been described by me as occurring in Chota Nagpur. All of them are in full foliage at the hottest time of the year. The wood is one of the most valuable for planks. The tree would be most useful on fire-lines at elevations over 1,500 feet on a sandy loam as in many places in the Balaghat and Bilaspur Divisions. I have raised the Central Provinces hill variety easily from seed even in Nagpur where it attained one foot in its first year, but it would probably not be suitable for general planting in the plains of those provinces and is quite unsuitable for cotton soil.

(5) Jamun (*Eugenia Jambolana*).—There are several varieties of this tree, possibly even two or more species mixed up under the one name, but they all agree in giving good shade during the hot weather months. The large-leaved valley variety also yields a comparatively large fruit. The wood is usually considered good. The hill variety will easily grow even on the more barren of our fire-lines.

(6) Nim (*Azadirachta indica*).—This beautiful tree grows in some of the forests of the Central Provinces as though it might possibly be indigenous. Certainly there would be no difficulty in growing it in most forests, but its greatest utility would be on the

cotton soil, where it grows to perfection and which is unsuitable to several of the preceding. Like the others it is in *full leaf* in the hot weather, and when well grown gives excellent shade. The wood is good. The whole tree is supposed to be germicidal and there is no doubt that it contains valuable antiseptic properties. The ripe fruits are largely collected for the oil which is especially useful in parasitic skin diseases and is also an anthelmintic. It is also a valuable camel fodder. It is best grown direct from seed without transplanting and, as it has few enemies, this is not difficult.

I believe that the above six trees are best suited to the dryer monsoon forests, but no doubt others could be suggested. Could we have avenues several feet deep on all our better fire-lines and fire-traces, the value of the forest property would not only be vastly increased but fire-protection would be rendered easier and less expensive, and the benefit of both man and beast in and adjacent to the forest would be very large. I look forward to the time when our timber cattle will be able to drag their loads along shady avenues, our elephants and camels capable of finding an abundant supply of fodder along every road, and travellers find shade and refreshment where now they toil along in the heat, and finally where Government will reap a large surplus of revenue instead of merely disbursing large sums on unproductive labour.

H. H. HAINES.

11th April, 1912.

A SHORT NOTE ON THE EARTH-EATING HABIT OF THE INDIAN DEER.

(BY PURAN SINGH, F.C.S.)

Some time ago, Mr. E. R. Stevens, Deputy Conservator of Forests, Ramnagar Division, United Provinces, sent to the writer two specimens of clayey earth from "Salt Licks" which bore the tooth-marks of the animals which had visited them, with a request for information as to what constituents the animals possibly obtain from them. One specimen was described as of a "clay salt-lick," and the other of a "sand stone salt-lick," the latter, it was stated, being very rarely met with. Following this Mr. B. B. Osmaston, Conservator of Forests, Western Circle, United Provinces, sent another specimen of a "clay salt-lick," together with two specimens of "deer droppings." Of the latter, one consisted of the ordinary goat-like droppings and the other of almost entirely of earthy matter, having been picked up close to the "clay salt-lick" from which a sample was taken by Mr. Osmaston. It was clear that the tooth-marks borne by the different samples of the "salt-licks" were those of the deer. The writer was informed by a friend, a sportsman of some experience, that he had often been to places frequented by *goral* and had seen them licking the earth. On tasting the clay of those particular spots, he found it distinctly saline.

The animals, at times, require a certain quantity of salt which, as is so well known, serves as a tonic and a stimulant. A good deal of salt required by their system, is derived from the food they take, but at times an extra quantity would seem to be essential.

Hence it is generally supposed that the deer eat clay in order to obtain the salt which it contains, especially as they are only seen licking particular spots in the forests.

Of the three samples of salt-licks examined, one gave no indication of saline matter while the other two gave a very slightly saltish taste when taken in the form of fine powder. The following table gives the results of the partial mechanical and chemical analysis of these three samples of earth :—

Table I.

Serial No.	Description of the sample.	Percentage of sand calculated on the air-dried material.	Clay silt per cent. on air-dried material.	Total aqueous extract per cent on air-dried material.	Percentage of common salt in the watery extract on air-dried material.	Percentage of common salt calculated on air-dried material *minus* sand.	Behaviour on moistening the powdered material.
1	Received from Mr. Stevens.—Appearance of a sand-stone when in lump, mixed with a yellowish clay. On powdering, it seemed to have the physical composition of a loam. The powder gave a very slightly saltish taste.	74·35	25·65	0.32 The residue gave a distinct taste of salt.	0·11	0·42	Emitted a sweet fragrant though somewhat earthy aroma; taste of clayey portion saline and more or less astringent.
2	Received from Mr. Stevens.—Appearance of a yellowish brown loam, tasteless.	71·37	28·63	0·22 No taste of salt.	0·028	0·097	Do. do. Appears to have no taste until the sand is removed.
3	Received from Mr. Osmaston—*Appearance of a ferruginous* clay of rosy ochre colour. When in suspension in water, the particles showed a red colour. The powder gave an indication of a saltish taste.	47·81	52·19	0·18 Distinct taste of salt.	0·06	0·11	Do.

In connection with the salt-lick, sample No. 3, the two specimens of "deer droppings" were examined with the following results:—

Table No. II.

Serial No.	Description.	Weight.	Sp. gr.	Loss on ignition per cent.	Ash per cent.	Soluble ash, on the total droppings per cent.	Insoluble ash on total droppings per cent.	Percentage of salt in the total "droppings" as determined in the soluble ash.
1	Healthy 'droppings,' appearance like goat excreta.	Numbering 14 in all, they weighed 8·4016 grms., the average weight of one being 0·6001.	0·748	87·94	12·06	0·51	11·55	0·09
2	"Droppings" of the deer that had eaten of the salt-lick No. 3 of the Table I. They were lumped together by twos and threes.	Numbering 16 in all, they weighed 35·8318 grms., the average weight of one being 2·2394.	1·697	11·36	88·64	0·92	87·77	0·079

From Table I, it is clear that the physical composition of Nos. 1 and 2 is similar, while No. 3 is more clayey. No. 1, when in lump, resembled sandstone, which, however, when powdered had the appearance of ordinary loam. It will also be seen that Nos. 1 and 3 are slightly saltish, and this was probably the attraction for the animals. No. 2 contains only 0·028 per cent of salt as compared with 0·11 per cent of No. 1 and 0·06 per cent of No. 3, and it seems comparatively poor in salt, though considering the quantity of salt contained in its clayey portion it contains almost as much salt as No. 3. The animals would be attracted by the saline clay that is contained in these sands rather than by the sand which in itself is tasteless. The quantity of salt, however, in all these samples is practically negligible, and it seems possible that the deer, like other animals, eat earth rather as a corrective to their system of digestion than for the salt contained in it. For example, it is generally accepted that elephants take mud to cure themselves of diarrhœa.

In this connection, it may be stated that Dr. H. H. Mann and Mr. D. Hooper have in their very interesting paper on "Earth-eating and the earth-eating habit in India" (*vide* Memoirs of the Asiatic Society of Bengal, Vol. I, pp. 249—270) discussed at length the abnormal taste of men and women for earth. The habit of eating earth by women, according to them, is occasionally found among almost every class and race of people. Clays, shales, alluvial muds, even sandy soils, are all used when once the habit is established. As to the cause of such a widespread habit they are inclined to attribute it primarily to the purely mechanical effect that the earthy matter seems to have in alleviating gastric or intestinal irritation. Gastric or similar irritation is inseparable from certain periods in a woman's life and these are precisely the periods when the earth-eating habit is contracted. In the same paper the medicinal uses of earth are discussed. Besides quoting the specific medicinal uses of small doses of earth given in oriental systems of medicine, a reference has also been made to a correspondence that appeared in the *British Medical Journal* on the subject. In the said Journal, a case was recorded of piles having been cured by

taking clay. A patient swallowed a bolus of about 1 drachm of yellow clay and next day he expressed himself as well. There was no abdominal pain, no diarrhœa, no blood, no heat or pain in the rectum. The same patient wrote that it was an old and common cure for piles and he knew it was always very successful. In another letter to the same Journal, it was stated that Hahnemann was the first to test alumina physiologically showing that it had a very decided action on the rectum and anus, producing constipation and symptoms of piles, which has provided homœpaths with indications for its use in these affections ever since. The general opinion expressed in the *British Medical Journal* appeared to be that its action is purely mechanical and analogous to that of bismuth and that the effect attributed to it—removal of pain and diarrhœa—is quite possible and solely due to the excessively fine state of division of the particles. The reasons given by Messrs. Mann and Hooper for the habit of earth-eating by men are :—

(1) A peculiar fascinating odour and taste in the clay rendering it a delicacy.

(2) An unnatural craving due to disease.

(3) To satisfy hunger.

(4) The force of example, and

(5) The supposed medicinal virtues.

Of these causes, some at least may be quite applicable to animals also, specially Nos. 1, 2 and 5. All the three samples of salt-licks under reference gave, on being moistened, a very fascinating odour, and the taste of the wet and fragrant clayey portion of each sample after the sand had been removed seemed to be a peculiar " delicacy."

When earth is in certain quarters, considered a useful medicine for man, it stands to reason, that owing to various disorders of the digestive apparatus, the animal instinct would naturally go to it for putting the digestive apparatus right. It may be instinctively sought for by animals to cure pain, diarrhœa, dysentery or any other form of intestinal irritation.

In conclusion, the most probable causes of the earth-eating habit of the deer, that suggest themselves, may be summarised as

follows: (1) to increase the salt in their system by eating and licking more or less saline earth, (2) an instinctive attraction that they may feel towards earth when their digestive organs are out of order, especially for relieving intestinal irritation, and (3) their choosing particular spots of clay may be due to well-marked symptoms of taste and odour that some soils possess. There is no special ingredient in these soils, unless it is salt, traces of which are found in them, which can be said to supply any food material to the deer.

SOWING AND PLANTING OF EUCALYPTUS IN THE DEHRA DUN DISTRICT.

Two species of Eucalyptus were tried in 1910: the *citriodora* or lemon-scented, and the *globulus* or blue gum, the seed having been supplied to me by an Indian zemindar who desired to make a plantation of the trees on a newly-acquired waste land in the district, and asked me to grow plants for him.

I sowed part of the seed of each kind in boxes filled with leaf mould, and part in the ground in ordinary garden soil dressed with an allowance of the same kind of manure. The boxes were eighty-six in number, each measuring 17 by 10 by 5 inches; and the ground plot was 15 by 8 feet. The situation was under the broken shade of a row of pear trees in my garden, open to the north-east, so that both the boxes and the ground plot could receive the morning sun up to about ten o'clock, and be thereafter protected not only from the sun but also from the cold of the night (in early spring). The boxes were placed on stones about four inches high to save them from white-ants, and the soil in the boxes was level with the top to prevent seedlings from growing "leggy."

The sowing was made in the evening of the 5th March in the following manner: the boxes and ground plot were watered very liberally from a watering can, the seeds were sown immediately on the wet surface, and were covered over forthwith with a sprinkling of fine sifted soil consisting of garden earth and leaf mould half and half.

The air in the ensuing fortnight was clear with the warmth of early spring in the day, and the nights, though chilly, were not too cold.

On the fourth day from the date of sowing, the soil, both in the boxes and in the ground plot, seemed to need more moisture, and I gave it a fresh watering very carefully so as not to bring the seeds to the surface. On the seventh day (from date of sowing) thousands of seeds germinated in the boxes, both varieties equally well. I counted 200 seedlings in one box ; and as all the boxes were about equally well stocked, I estimated roughly that there were in the forty-three boxes sown with the lemon-scented kind about 8,000 plants and a like number in the forty-three boxes containing the "blue gum" species. There were thus about 16,000 seedlings in the eighty-six boxes. The seeds in the ground took a longer time to germinate: they received another careful watering, began to germinate on the twelfth morning from the date of sowing and continued coming out in the next three or four days, when the plot became as well stocked with seedlings as the boxes. Roughly stated, there were about 4,000 plants of each of the two kinds, or say, about 8,000 in all in the ground.

In the last week of March, or about twenty days from date of sowing, the seedlings of both kinds in the boxes were throwing out their second set of leaves; they were almost two inches high, and both kinds were progressing equally well, the *citriodora* perhaps a little better. In the ground the seedlings of both kinds were less advanced ; they were about one inch high, their secondary leaves (when they came out) were smaller; the plants were of smaller size than those in the boxes, but otherwise they were quite healthy.

About the 26th March, a thunderstorm burst upon us with rain and slight hail; temperature fell suddenly, the nights became quite chilly, and there was much moisture in the soil. Within two days from this rapid change several young plants, principally in the boxes, began to droop, and within a week several hundreds of those in the boxes had died. On removing the boxes at the first sign of drooping to bring them out more into the open air and sunshine, I discovered three things : some of the drooping plants

had been struck by the hail, others had apparently suffered from too much moisture, and not a few had their roots eaten by white-ants which attacked them from underneath, and from the sides of the boxes (the sides were touching one another though the boxes were raised from the ground). The plants in the ground were slightly injured here and there by the hail, but were otherwise scarcely affected.

In the middle of April, that is, about a month and a half from the date of sowing, I transplanted one good specimen plant of each kind into as many good-sized pots, to see how they would stand transplantation at that early period of their growth ; and I took the opportunity of examining them, with the following results stated in inches:—

		Height.	Root.	No. of leaves.
From the boxes—				
Citriodora	...	3	$3\frac{1}{2}$	Two sets.
Globulus	...	$2\frac{3}{4}$	3	,,
From the ground—				
Citriodora	...	2	2	One set.
Globulus	...	$1\frac{1}{2}$	$1\frac{1}{2}$	,,

When placing the plants in the pots care was, of course, taken to keep their extraordinarily long roots in their natural position, a detail which Indians often neglect. The four pots were watered liberally, and placed beside the boxes and the ground plot respectively. Thereafter the same treatment was given to the whole undertaking, that is, the soil was kept moist without flooding, and excess of sun was avoided.

By the end of April the increasing warmth and dryness of summer had no injurious effect on the plants in the broken shade, either in the boxes, in the ground, or in the pots. The plants continued to make very satisfactory progress all through April and May.

At the end of the latter month the *citriodora* seedlings in the boxes were from five to seven inches high ; the *globulus* in the boxes were very little less ; both had a healthy breadth, and their leaves were very fine. I reckoned that there were now about 3,000 plants of each of the two kinds in the boxes. (I had started

with 8,000 seedlings of each kind as stated above.) In the ground plot both kinds were less, being about three to four inches high, and less broad; their leaves also were of smaller size, but the plants seemed hardier; and, roughly stated, there were about 3,000 plants of each kind (I had started with about 4,000 seedlings as stated above).

I now advised my friend, the zemindar, to arrange for the removal of all the plants to his estate a little before the beginning of the rains, to keep them there under the same conditions as in my garden, and to plant them out into their permanent location as soon as the rains had set in, care being taken to avoid rain-water lodging round the roots of the plants. The boxes could be carried bodily, and the plants in my ground would be potted under my supervision before removal.

Two unfortunate errors were made. The boxes were removed rightly enough on carts in the first days of June; but when two days later I visited the estate to see the permanent location, I saw to my consternation that nearly all the boxes had already been emptied, the plants had already been put into a wide nursery ground near a stream, and had been flooded with water according to the pernicious local habit! The result could not be anything but disastrous: and in a few days practically the whole supply of the splendid young plants from the boxes had perished.

The second error was made in the size of the pots for the plants in my ground. I had pointed out and explained the length of the roots and the necessity for suitably deep pots. To my disappointment, when about four thousand pots came, they were all less than five inches deep, they should have been seven inches. Into the limited depth the plants were potted in the first ten days of June and watered diligently every day; and such was their power of endurance in the limited space and the warmth of the mid-summer days (in this district) that not ten in a hundred had died when the rains began. But their progress was much impeded, and for fear of losing them they were kept under my charge until the beginning of July, when they were removed to the estate (both the *citriodora* and the *globulus*), and were planted out eight feet apart in chess-

board fashion suggested by me, and no depression was allowed around the roots.

It is now two years since they were planted out, and I learn that they have made a fairly large plantation, in which both the *citriodora* and the *globulus* are mixed up, the trees standing already from eight to fourteen feet high. Had the two above-mentioned errors not been made, the plantation might have been twice as extensive.

It would be unwise, from one trial, to draw conclusions for future guidance in sowing and planting Eucalyptus in this, or any other district in Northern India, though the results seem to indicate that what is needed are a good supply of leaf mould, deep tillage, broken shade, equable spring temperature, and moisture (without too much water) in the soil.

Another trial is in hand this year with the lemon-scented species, and I hope to send some notes later on.

DEHRA DUN : L. LIOTARD.
12th April, 1912.

ANTISEPTICS—*AVENARIUS CARBOLINEUM.*

Note on the antiseptic treatment of 400 *Pinus excelsa* (Kail) and 326 *Pinus longifolia* (Chir) B. G. sleepers with *Avenarius Carbolineum* oil at Jagadhri by Forest Economist.

1. *Size of tank used,* 11′ 3″ × 3′ 9″ × 2′ 10″.—This is too large and requires much oil to fill it sufficiently to flood the sleepers. It should be made 10′ 3″ × 3′ 3″ × 2′, a tank of this size will treat 6 sleepers at a time, which is as much as can be conveniently lifted by a compound pulley fixed at a tripod.

2. *Experiments made as to absorption.*—The figure within which it was proposed to work was 3 lbs. of oil per sleeper, at an estimated cost of 7·2 annas per sleeper. Six sleepers were weighed

of each species before and after treatment having been immersed for 10 minutes. The following were the results :—

PINUS EXCELSA.			*PINUS LONGIFOLIA.*		
Serial No.	Weight before immersion in lbs.	Weight after immersion in lbs.	Serial No.	Weight before immersion in *lbs.*	Weight after immersion in *lbs.*
1	117	$122\frac{1}{2}$	1	132	138
2	$112\frac{1}{2}$	115	2	127	$132\frac{1}{4}$
3	$144\frac{1}{2}$	147	3	149	$158\frac{1}{2}$
4	93	$95\frac{1}{2}$	4	159	167
5	$121\frac{1}{2}$	122	5	$141\frac{3}{4}$	$149\frac{1}{2}$
6	$94\frac{1}{2}$	97	6	147	$150\frac{1}{2}$
Total.	683	699	Total.	$855\frac{3}{4}$	$895\frac{3}{4}$

The absorption of oil by 6 sleepers of *Pinus excelsa* was therefore 16lbs. and *P. longifolia* 40lbs. So as to work approximately to 3 lbs. per sleeper the time of immersion was extended to 15 minutes for the former species and reduced to 5 for the latter; at the end of the work it was found that owing to the excessive absorption of Chir it would have been better to put the immersion period at 3 or 4 minutes.

3. *Temperature of oil.*—In the case of *Pinus excelsa* the temperature was kept at 80° C. or a little over. As this temperature in the case of *Pinus longifolia* appeared to cause the small cracks in the timber to expand the temperature was lowered to 50° C.

4. *Method of working.*—The tank was sunk nearly flush with the ground, and under it a flue was made, running the entire length of the tank, in which a fire was kept burning. Over a tank a tripod some 8 feet high was erected, to the top of which the upper pulley was fastened, while the lower one was furnished with stout hook. Two pairs of parallel sleepers were placed on each side of the tank and at right angles to it to receive the sleepers. The sleepers to be treated were made up in parcels of 6 and placed on each side of the tank so as to rest on the parallel sleepers. They were kept apart with battens laid horizontally between the upper

and lower three, and also vertical battens, with a notch at the top to keep each pair apart. Round each end a wire rope ($1\frac{1}{2}''$ circumference) was looped, and connected by another wire rope furnished with hooks at each end which passed over the pulley hook. The first lot of sleepers was then swung into the tank and in order to sink them, a by no means easy business, the second lot was placed on the top. After the immersion period the top lot was removed and slung to one side of the tank and the treated lot hoisted, allowed to drip for a few minutes, and then slung to the opposite side of the tank and then removed to the stacking ground. The upper lot were then again slung into the tank and in their turn treated while a new lot was placed upon them to weigh them down.

The time taken to treat sleepers depended on the time of immersion, it was found with 15 minutes' immersion, it took 3 minutes to allow for drip and 7 minutes to remove and re-charge the tank, therefore 25 minutes in all to treat 6 sleepers. This was the average for several days' work. The *Pinus longifolia* sleepers were considerably heavier than the Kail sleepers, but absorbed the oil much faster. A mistake was made in calculating the total amount of oil necessary to treat 800 sleepers; working on a 3lbs. per sleeper average it requires 2,400lbs. of oil and only 2,600lbs. were obtained, so that the 200lbs. margin proved insufficient, quite 800lbs. surplus was necessary.

5. *Labour.*—It requires 12 men to keep the tank supplied and two carpenters to slot the sleepers to receive the zinc numbers, to prepare battens, etc. The slotting was done before the sleepers were immersed and the stamping of additional marks two or three days after immersion, when the sleepers were thoroughly dry.

6. *Depth of impregnation.*—Directly the sleepers came out of the tank, the depth to which the oil had penetrated was found to be not more then $\frac{1}{8}''$ on the sides and $\frac{1}{8}''$ at the ends. The oil, however, continued to penetrate for several days after treatment. In the case of *Pinus excelsa* after 15 minutes' immersion and after 3 or 4 days the oil had penetrated $\frac{1}{8}''$ to $\frac{3}{16}''$ on the sides and $\frac{3}{8}''$ to $\frac{1}{2}''$ at the ends, in the case of *P. longifolia* with 5 minutes'

immersion it had penetrated $\frac{1}{4}''$ to $\frac{3}{8}''$ on the sides and $\frac{1}{2}''$ to $\frac{3}{4}''$ or even as much as 1" at the ends.

7. *Amount of oil actually used.*—2,789lbs. to 726 sleepers or 3·84lbs. per sleeper.

R. S. PEARSON,
Forest Economist.

25*th April* 1912.

NATURAL REGENERATION IN FORESTRY.

On no other subject connected with forestry has there been so much discussion as on the question of artificial *versus* natural regeneration. There are so many things to be taken into consideration when discussing such subjects, and as is usual in all arguments, too much stress is laid upon the advantages of the one system and the disadvantages of the other. This is particularly evident in most of the older works on sylviculture, so that the beginner may take up one book, and after reading it, become a firm believer in natural regeneration, only to go over completely

to the other side after reading a book by an author who favours the other method. Nowadays there are few writers who favour one way or the other, the safest ground being between the two. A German book which appeared in 1907 discusses all the various sylvicultural systems and methods of management with their merits and demerits, and concludes by giving the palm to that method of natural regeneration known as the strip system. We refer to *Die Grundlagen der Räumlichen Ordnung im Walde*, by Dr. C. Wagner, which reached a second edition in 1911.

The method of working the system depends upon the direction of the prevailing rain-bringing winds and the sun's rays. Dr. Wagner's aim is to combine as much moisture as possible with protection from the drying influence of the sun, and to carry out the regeneration in such a way that the timber can be taken out with the minimum of injury to the undergrowth. In addition, the working of it must be simple enough to be carried out by anyone of moderate intelligence.

A steady rainfall without much wind favours no particular part of a wood, so that it may be looked upon as a negligible factor. The decisive factor which makes all the difference on the borders of a wood (and it is on the borders that the regeneration takes place) is rain accompanied by storm and strong wind. As most storms in our part of the world come from the west and south-west, the strip of ground on the east border gets none of this additional moisture, whilst it is driven well into the west side by the force of the wind. The drying power of the sun's rays is exerted from the south-east, south, and south-west. In consequence, the east border, in addition to getting no additional water, is exposed to the action of the sun's rays for a considerable part of the day, and is rendered absolutely unsuitable for natural regeneration. The south and west borders get the additional moisture, but the afternoon sun evaporates most of it again, and for obvious reasons it would be unwise to attempt to rejuvenate high forest by starting from the west or south sides. The only borders which combine shade and moisture are those to the north-west and north, and they are at the same time well sheltered from

the prevalent storms. The north-west side is perhaps a little dangerous, but the north is absolutely safe, as it has the advantage of being protected from late frosts, as the plants remain dormant longer than when exposed to the sun and warm winds.

The superiority of the north border is the secret of the whole system. Dr. Wagner starts his regeneration from the north, by judicious thinnings in a long, narrow strip extending from west to east. As soon as the seedlings have got hold and are well established, the strip is widened and the timber on the first strip gradually removed. This process goes on through the whole wood, no part of the ground being laid bare until it is well stocked with seedlings, so that there is no danger of the whole wood being ruined by the failure of a good seed year, as so often happens when other systems are employed.

The method is similar to Gayer's strip system, but the strips are narrower (about half as wide as the height of the adjoining trees), and are themselves more or less uneven-aged, according to whether they have been regenerated in the course of one or of several seed years. Gayer recommends that the fellings be conducted against the wind, or, in other words, from east to west. Progress is more rapid by the latter method when seed years occur frequently, but as no advantage is taken of intermediate seed years, it may be very slow indeed. In Wagner's system progress can be hastened to any degree by working simultaneously from several lines of attack. The timber is always thrown towards the old wood, and can be taken out in the same direction, so that there is no danger of serious damage to the young growth. The wood, when completely restocked, presents a strange appearance, more or less like the teeth of a saw, the trees gradually increasing in size with advancing age, until the second line of attack, when there is an abrupt fall again to the seedling stage, followed by another gradual rise up to the third line, and so on.

Dr. Wagner claims that this system is preferable to all others in nearly all situations and for practically all kinds of trees. He gives a number of rules which must be followed in mountainous districts. There is no doubt that he has obtained excellent results

in his forest in Geildorf, South Germany, and there is no lack of supporters of his system in other parts of Europe. The system is certainly one of considerable merit, and ought to succeed well in the moist climate of the British Islands. It would be interesting to know whether any experiments on similar lines have been carried out in this country, and with what degree of success.

Dr. Wagner's system has its opponents as well as its supporters. We are inclined to think that he claims too much for it, as it is impossible to give one universal rule to fit all circumstances, and although we know of many woods where there would probably be no difficulty, we know of as many others, old pine, for instance, with a good thick layer of raw humus and weeds, where the system could not be a success. Mere theorists, who condemn the system because it relies upon natural regeneration, or for some other reason, do not deserve attention.—[*The Field.*]

THE IRRITANT ACTION OF SATINWOOD.

Two varieties of satinwood come into commerce distinguished according to their origin as East Indian and West Indian. The former is derived from *Chloroxylon Swietenia*, D.C., and the latter from *Zanthoxylum flavum*, Vahl. Both woods are used in cabinet and furniture-making, and in the decoration of ships' cabins, and for other similar ornamental work. In 1898 and again in 1904 there were complaints from workmen using satinwood in this country that it produced severe skin eruptions, and at that time a number of articles dealing with the skin irritation produced by satinwood were published by medical men who had come into contact with such cases (Jones, *British Medical Journal*, June 25th, 1904; Bidie, *ibid.*, January 14th, 1905; Graham, *ibid.*, April 15th, 1905).

At first there was some doubt as to whether one or both varieties of satinwood produced these effects, but in the *Annual Report of the Chief Inspector of Factories* for 1907 it is made clear that the outbreaks which have occurred in East London, Glasgow and Bristol, were all due to East Indian satinwood, and that the West Indian wood has not so far caused trouble of this kind.

The attention of the Imperial Institute was directed to this question in 1904 by Mr. J. Whitton, Superintendent of Parks, and Curator of Botanic Gardens, Glasgow, who forwarded small supplies of the wood which was then producing trouble of this kind in shipyards in Glasgow.

The investigation of both kinds of satinwood was undertaken at the Imperial Institute, and a short note on the constituents of the East Indian satinwood was published in this *Bulletin* (1909, 7. 93) fuller details of the scientific work being given in the *Transactions of the Chemical Society* (1909, 95. 964) in a paper by Dr. Auld of this Department. In this it was shown that the East Indian satinwood contains an alkaloid *chloroxylonine*, two resins, one amorphous and the other crystalline, and a fixed oil, and the chief characters of these substances were described.

The pharmacological action of the timber and of the constituents referred to above, prepared at the Imperial Institute, has been investigated by Prof. J. T. Cash, F. R. S. of Aberdeen University, and the results of his experiments have been published recently in the *British Medical Journal* (October 7, 1911).

Damp satinwood sawdust was kept applied to the arm for 15 hours daily. On the morning of the fourth day there was considerable irritation, with redness. The irritation increased, especially at night, and after six days, desquamation ensued, and was very evident for the succeeding ten days. Irritation continued at intervals for three weeks after its first development; it was worst after exercise, or under the influence of warmth. Sawdust moistened with almond-oil proved rather more effective in its action than that moistened with water, whilst the dry dust was less rapid than either of the foregoing in producing its action.

The alkaloid chloroxylonine and its salts (the hydrochloride and nitrate), applied either as an ointment or in alcoholic solution, proved, towards two out of three individuals, insidious but powerful irritants. In neither case was there any effect on the first application, but definite symptoms appeared after an interval of four days in one case and twenty-two days in the other, from the date of a second application. Subsequent applications acted with much greater rapidity.

Of the non-alkaloidal principles contained in East Indian satinwood, No. I resin, an amorphous substance soluble in alkalis, was not irritant to the skin of normal individuals. No. II resin, a crystalline substance sparingly soluble in alkalis, produced a slight irritant effect in one instance where there had been no previous dermatitis. The fixed oil, which is viscous, yellowish-brown in colour, and has a specific gravity 0·965, caused no irritation when applied to the normal skin. To individuals, however, who had already experienced a chloroxylonine dermatitis all three substances acted as irritants: No. II resin being very active, No. I resin moderately so, and the fixed oil slightly active.

No explanation can at present be suggested for the apparent immunity of one of the subjects of chloroxylonine application, but this is in harmony with what has been observed among satin-wood workers. Thus Jones and others have pointed out that only some of the workers using this wood suffer in any way from handling it. Prof. Cash's results also confirm the observations previously recorded that certain workers appear to become much more sensitive to the irritant action of satinwood once they have suffered from dermatitis caused by this wood. On the other hand, no case was met with in these experiments in which a subject acquired a sort of immunity as the result of a first attack of dermatitis, though this has been stated to occur among satinwood workers.

A number of samples of this wood have been examined at the Imperial Institute since 1904, and the results show that about 50 per cent of the samples contain only traces of alkaloid. In other cases amounts varying from 0·013 to 0·07 per cent. have been found. This variation in the amount of chloroxylonine present no doubt accounts for the fact that outbreaks of satinwood dermatitis among workmen occurred only occasionally. The *Report of the Chief Inspector of Factories* for 1907, already referred to, indicates that the East Indian satinwood is less used than formerly, and that where it is used fans are employed to remove the sawdust, so that the latter does not come into contact with the faces and hands of the workers.—[*Bulletin of the Imperial Institute.*]

PINE FIBRE

During the last few years a new textile industry has arisen in which pine fibre, in the form of paper made from wood-pulp, is employed. An article on the subject, by C. P. Hellberg, of Sweden, has appeared in the *Textile Institute Journal* (1911, 2. 33). The paper is cut into strips, which are spun into yarn on a ring spindle. This paper yarn is said to be suitable for packing-twine and cords, whilst carpets made from it are already in great demand on the Continent. It can be combined with cotton for the manufacture of upholstery fabrics and workmen's aprons, and will doubtless compete with jute for the production of oil-cloth and sacking. The paper yarn is not damaged by water, either hot or cold.—[*Bulletin of the Imperial Institute.*]

COMPRESSED PAPER AS A SUBSTITUTE FOR WOOD.

The *Standard* refers to the extraordinary progress now being made in the adaptability of compressed paper, and states that an American engineer, now in London, has a certain secret adhesive process and improved machinery, which turns out, at a minimum of cost, almost every article that has hitherto been made of wood and a great many more things usually seen in earthenware, china, glass, or tin. A factory is at work in Gera (Germany), and similar factories are to be started in Paris and London. Specimens of manufactures include perfectly made barrels for packing any sort of provisions, including fish ; drums for chemicals, piping of every diameter, electric insulators, pots for chemists and druggists printing rollers, clothes and hat boxes, tool handles, and a dozen more different descriptions.

" There is nothing that we shall not be able to do with this compressed paper as soon as we have the necessary machinery," said one of the holders of the patents to the representative of our contemporary. " Not only are we going to revolutionise cost of manufacture, but also, thanks to the far lesser weight of the goods, all freight charges. In the case of chemists' jars, we shall also save in the breakage.

"All kinds of furniture, roll-top desks, bed-steads, chairs, motor car bodies, and even railroad vans are only a matter of sufficient plant—that is, machinery; but meanwhile we shall content ourselves with turning out drums for chemicals, butter firkins, and multitudinous small articles, particularly pulleys of all descriptions and electric insulators. Wood is often costly, and is liable to warp and split according to atmospheric influences of heat or cold or damp. Compressed paper, under our process, never varies, and is absolutely impervious to cold or heat, damp or steam. I can show you pulleys which have been tested for three years over a steam vat: not the slightest impression is visible. These drums for chemicals are absolutely acid proof, and show a saving of 75 per cent. on manufacture as against iron, and just half the cost in freight. I will guarantee a saving of thousands a year to manufacturers using many cardboard boxes, and as for trunks—well, the only thing that comes near us is split cane; but we beat split cane in durability and climatic conditions."

An important syndicate is in course of formation to acquire the patents in every country which have been secured by the American engineer, who regards his process as flawless.

Every goods barrel in these islands will have to be made of my compressed paper before many months pass, and in that industry alone—making barrels there are millions.—[*The World's Paper Trade Review.*]

THE USE OF ROSIN IN PAPER MAKING.

Rosin which, by the way, is now being produced in the Punjab, is an indispensable article for paper making, and in view of its constantly increasing price and the fluctuating of the market, a substitute has long been sought which will give the same results in paper sizing. In Germany the large price of £5,000 has been offered for a solution of the problem, but so far no competitor has come forward.

The Union of Paper and Cellulose Chemists has studied the question, but without finding any satisfactory solution, and it is not likely that the problem will be solved soon.

Several reports were read to the meeting of chemists at Berlin, and those of Dr. Klemm and Professor Schwalbe were very informative, both on the subject of the research for new rosinous substances and on the question of economising the quantities of rosin at present used. Both of these chemists suggested that the rosin should be helped out with other materials such as starch, casein and tanning size.

Resinous waste, a by-product in pulp making, has been tried in a paper mill in Sweden, but although this product, which has been called liquid rosin, has given fairly good results at this mill, its employment has not been generalised.

Dr. Klemm suggests especially for printings, mineral sizing by means of combinations of salicic acid with alumina, barium or lime.

In the majority of printing papers the aim of sizing is not so much to make the paper impermeable to water or ink as to serve to agglutinate the fibres in order to give more solidity and endurance to the paper. From this point of view mineral sizing should be even superior to rosin sizing, in so far as the fibres, the weighing materials, such as china clay, and the colours, are more closely combined, and, therefore, a better printing surface is obtained. Moreover, this method of sizing prevents the paper from turning yellow, which is an advantage in high-class printings.

The diminution of the use of rosin resulting from the adoption of these mineral sizes is not very large. Taking an average of 1½ per cent of rosin used for the 300,000 tons of printing paper made in Germany, the use of mineral sizes would save 4,500 tons of rosin, of a value of about £25,000. Dr. Klemm is confident that this mineral sizing will be adopted sooner or later in all paper mills making printings.

As for *artificial rosin,* the manufacture is an accomplished fact. Several chemists have produced a synthetic rosin by means of aldehydes and phenols, but this product is altogether too expensive, and the solution of the problem depends upon the question of price.

Professor Schwalbe reviewed the divers materials which might serve to size paper or to economise a part of the rosin.

He divided these into two classes in organic colloids, such as salicic acid and the hydrates of alumina, and organic colloids. The question is whether after use these colloids preserve their agglutinant qualities.

The organic colloids are very numerous and may be classed under four heads : those which are soluble in water ; those which swell up under the same influence ; those which form emulsions, and substances soluble in alcohol. Gelatine belongs to the first group, and this is already used in paper making. Fish glue and several vegetable gums could be used more or less for sizing, but they are out of the question, as they are dearer than rosin.

The substances which swell up include starch, gum tragacanth, mucilages and seaweed preparations. These have been tried in paper making, but without any great success, either because of their high price or by reason of imperfect preparations. Viscose also belongs to this group ; it gives a solid paper, but not always impermeable to ink.

Several preparations of cellulose might very well be experimented upon.

The third category includes substances insoluble in water and not susceptible to swelling—that is to say, rosin, fatty matters and waxes. In order to be used in sizing they must be able to form an emulsion, which will remain unchanged while the paper is passing over the drying cylinder. Rosin itself is the type of this class ; it forms an emulsion in the state of free rosin either by the aid of soap or by other well known methods.

There are certain exotic substances which might be tried in a state of emulsion, but their price will be an obstacle in paper mill use, even supposing that they are capable of replacing rosin.

As already stated, artificial rosin is too expensive. An American inventor, Mr. Baekeland, produces artificial rosin by using six molecules of phenol and seven molecules of formaldehyde, so that it is evident this would be much dearer than the natural product.

The fourth class of colloids consists of substances saponifiable with an alkali ; these deposit an amorphous precipitate on the

fibre. Soap itself might be used, but its high price is against it, and casein is in the same category, and this also costs too much. Already in the case of special papers colloid matters dearer than rosin have been used with it, but the problem to solve is, if not to supplant rosin, at least to find a cheaper substance to use with it.

Tannin size and silicate of soda seem to fulfil the conditions. A mixture of sulphate of alumina with sulphate of magnesium or with free sulphuric acid can replace the first of these products, and is much cheaper.

But this is a palliative only, not solution of the problem. Of the various substances mentioned only the inorganic colloids and the mucilaginous bodies are worth considering. The former may be used for printing papers, but it is feared that the latter will only partially fill the desired conditions.—[*Oil and Colour Trades Journal.*]

FIBRE SANDALS.

A very important industry is carried on in Spain in the manufacture of a sort of a sandal or slipper known by the name of *espadrille*, which is in general use among the poorer classes, and is also exported in large quantities to other countries. According to a United States Consular Trade Report the total number exported to Cuba, Algeria, Argentine, Italy, France, Mexico, Panama, Philippines, Porto Rico and other countries amounted to 403,439 dozens in 1909.

They are made of plaited soles of jute or hemp cord about a quarter inch thick. To this sole is sewn an "upper" piece of cotton canvas, rather lower in height than a shoe, and it is attached by tapes fixed to the upper edge and bound round the ankle. The favourite colours are white, black, red, blue and dark-grey in the above order. There is a very large home consumption in Spain, which is supplied by small workshops distributed in the industrial quarters of all Spanish towns. Barcelona alone possesses 209, Madrid 94, and Valencia 78, where the work is either entirely by hand or machine-made parts are put together by hand.

In addition there are factories for the manufacture of soles by machinery, but the development of automatic machines similar to those used in the boot trade progresses very slowly. Espadrilles are nevertheless made very cheaply and are sold at from Rs. 3 to Rs. 3—7½ per dozen pairs or from 7½ to 9 annas retail per pair.

The cheapest have jute soles, and a better quality have soles of hemp and sell from 10 to 15 annas per pair. Workpeople are paid at the rate of Re. 1-4-0 for men, 15 to 18 annas for women, and 11 to 13 annas for children per day. Workers make from two to three pairs per day, men making the large sizes, women the intermediate, and children the smaller ones. In the Basque Provinces the production is estimated at 10,000 to 12,000 pairs per day.

Here is an industry that might, with every prospect of success, be taken up in India. All the materials are produced locally. Woven soles of cotton are a well-known product of our jails, the espadrille is suitable for people who object to wear leather, and there is abundance of labour of a suitable kind, for the work is much more easy to learn than handloom weaving. The tools are those of the mochi, but, as leather is not used, there can be no caste prejudice against the work which might find occupation for agriculturists in the enforced intervals of field work. Raw materials could be distributed and the finished articles collected in villages by the same organisation as serves the handloom weavers.

A rival material for the same footwear for indoor use is paper, which, when cut, spun and woven, makes mats and cloths of various qualities. For the manufacture of soles it has the advantage of being a good non-conductor.—[*Indian Textile Journal.*]

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PYINMANA FOREST DIVISION: TEAK AND BAMBOOS IN BURMA.

I.—General Remarks.

1. The object in view in writing this paper is twofold: there is first of all a desire to re-awaken the interest in the flowering of bamboos which was aroused some years ago over the Kyathaung (*Bambusa polymorpha*); and secondly, as a result of a study of the flowering of bamboos, to suggest that a stronger line should be taken in respect to fire-protection, and that in the present exceptionally straitened financial condition of the province, as a temporary measure at least, all or nearly all the expenditure on fire-protection in Pyinmana and in other divisions where similar conditions prevail ought to be diverted to other works of development and improvement, which are being starved for want of funds.

2. How much is known and how much is buried away in office records as to the distribution and flowering of bamboos it would be hard to say. My own case is probably typical of many. After adding the few facts I have gleaned for myself

in the forests to what I have picked up in the Pyinmana office, in annual reports and in the pages of the *Indian Forester*, I am still hopelessly at sea over many important details. There are no maps showing the distribution of any species of bamboo other than *kyathaung* (and that only a rough tracing on a small scale). The *tin* (*Cephalostachyum pergracile*) has flowered gregariously over the whole division at intervals during the past 30 years, and yet I am reduced to guess work and to questioning villagers in order to trace its course. There is not even a map of the burst of gregarious flowering that took place in 1907 and 1908. Two minor bamboos, *myin* and *wannwe*, are now in flower, but I can only guess at the area likely to be affected.

3. The idea has long been current that *the flowering of bamboos is the key to the solution of the problem of teak regeneration in bamboo forests.* Until quite recently I did not realise in the least what was meant by the expression and passed it by. Now that I know, and am fully convinced of its truth, the subject has become of absorbing interest which I would like to communicate to others before going on leave.

The subject is not given anything like the attention it deserves. If it is the key it rests with us to make it fit the lock, or rather it rests with us to fit all the keys represented by all the important species of bamboo in Burma. Endless time will be lost if the business is not tackled systematically, and if it is not given a prominent position all to itself. Fragmentary remarks in annual reports are certainly not good enough.

It is first of all essential that all known information be brought together and published, so as to be within the reach of all foresters in the province. It is equally important that an organised attempt be made to fill up the blanks which at present exist in our knowledge of the habits and distribution of the bamboos. It remains to be seen how best to carry out this idea. A provincial conference would probably be the simplest way of settling details. May it soon meet!

4. Everyone knows how exceptionally gloomy the financial outlook is at present. Exceptional conditions call for exceptional

remedies. This is my excuse for venturing to suggest that we are justified in moving faster in respect to the abandonment of fire protection undertaken for the sake of regeneration.

In the selection of all areas hitherto brought under protection from fire, regeneration is all that has been thought of. Prevention of damage to trees and timber has only come to the front in recent years, and, more often than not, simply to bolster up the case for regeneration protection. The two matters ought to be treated quite independently (para. 31). It only obscures the real points at issue to try and deal with both together.

In the memorandum which appeared in the *Indian Forester* for December 1906, Mr. Beadon Bryant went so far as to condemn utterly continuous fire-protection for the sake of regeneration in moist forests, but before coming to a decision with regard to the less moist and dry types, he wished to have a series of experiments started. As more than half the protected forests are of the moist type one would have expected to see a marked decline in the area under protection in the past five years. Here are the actuals :—

Year.	Area under protection.	Cost A VIII f.
	Sq. miles.	Rs.
1906-07 ...	8,153	2,89,701
1907-08 ...	7,527	2,73,468
1908-09 ...	7,457	2,57,081
1909-10 ...	7,728	2,92,130
1910-11 ...	7,468	2,67,481

The inference seems to be that we have rather lost sight of the real point at issue. Whilst waiting for the results of experiments in dry forests we have overlooked the fact that the case has already gone definitely against continuous protection of moist forests. Rather an expensive mistake, it is true. Well over five lakhs already, and mounting up at a lakh or more a year!

Now that continuous protection even in dry forests is on its trial, ought not the whole of our operations to be looked upon as a gigantic experiment? Once this is recognised, the next step is obviously to reduce the operations to the dimensions of an experiment, and not to allow them any longer to usurp a position to which they are not entitled.

Another point: as it is very doubtful if continuous protection will prove to be good even in dry forests, and as we are so hard up for money, why not start a break in the continuity of the protection now?

Lastly, it is a mistake to suppose that the burning of a forest in Burma means undoing much of the effect of the previous protection. The *sal* forests of Northern India are in a totally different position to the teak forests in Burma. The former fit in with the ideas we brought from home, the latter do not. Most of the leaves shed in the Burma forests disappear absolutely in the following rains. Teak and bamboo leaves certainly do. At the most, therefore, the burning of such forests would only put the clock back a couple of years, and probably only one if the burning were done early. A realisation of this fact may come as a surprise to officers who have not previously thought about it, and should help to remove the objection some men have professionally.

5. Perusal of forest administration reports for the past five years is sufficient to bring out the need there is for a stronger line being taken with regard to bamboos and fire-protection. Expenditure on the latter for the sake of regeneration ought to be limited to those areas in which there is a reasonable probability of its being beneficial. It would not be unreasonable to go a step further and to ask that it be limited to the class of areas in which it proved to be an unqualified success.

The gregarious flowering of *tin* has been almost as widespread in the Southern Circle as in the Northern Circle. In the latter, experimental burning was started in 1906-07, and following years. In 1910-11 in one division alone 242 square miles of forest was thrown out. This certainly looks as though the business was getting beyond the preliminary experimental stage. Nevertheless

since 1907-08 the Southern Circle has been marking time in respect to flowered *tin* and fire-protection. It would indeed appear to have gone backward, 190 square miles of forest has been added in Minbu to the area under protection "in accordance with the provisions of the Taungdwingyi working-plan." I wrote that working-plan, and, at the time of doing so, had only been in Burma two years and had seen little or nothing to lead me to re-adjust the ideas on fire-protection learnt in the *sal* forests of Northern India. The word *wathon* had not been added to my vocabulary. Five years have gone by, and I have now no hesitation whatever in saying that my plan is not itself sufficient justification for increasing expenditure on protection—(see also remarks in para. 12).

6. My chief object in writing this paper is to discuss the flowering of *tin*. I should not have gone into print at all if I had not hoped to take leave shortly, and I should certainly not have brought in anything about fire-protection, if my enquiries with regard to *tin* had not convinced me that nine-tenths of the expenditure on fire-protection in Pyinmana is not only waste of money but actively harmful. I am firmly convinced that wherever *tin* has flowered in Pyinmana within the past 30 years, the effect of our protection is exactly the same as if we had spent the money on hiring men to hack at all the young teak they could find in *wathon* areas, and for the divisional officer and his assistants to spend a good deal of their time in seeing that none escaped. A good deal of the balance of the divisional officer's time has been taken up with enquiring into fires, running people in for starting them, and writing reports deploring the damage done! Are we all puppets in a burlesque?

In the *Indian Forester* for April 1912 is an article by Mr. Walker on "Sylviculture in Burma". Thanks are due to Mr. Walker for the courageous way in which he has put forward the case against protection during the past 10 years. Mr. Walker winds up his article with a very striking phrase:—"*The retention of fire-protection may have been forced upon us in spite of our wishes and experience.*" Is this true?

II.—Flowering of the Tin Bamboo.

7. The Burmese name (*tin*) for *Cephalostachyum pergracile* is so short and convenient that I hope to be excused for using it freely. The Burmese for seedling bamboo growth (*wathon*) is also so much shorter than its English equivalent that it is frequently employed.

8. In the *Indian Forester* for September 1904 there is an article on "Reproduction of Teak in Areas of Flowered Bamboo" which is well worth reading. I refer to it for the sake of the following extract:—

> "But I have often wondered why there is this interminable writing about and this interminable waiting for the flowering of a particular bamboo, when many others, spread over areas at least as extensive as those occupied by *kyathaung*, are ignored. Why are no schemes prepared for *tinwa* which extends over enormous areas both in Upper and Lower Burma, and the gregarious flowering of which I have myself witnessed on more than one occasion; or for *myinwa* (*D. strictus*) which flowers yearly to a greater or less extent in almost every division in which it is found; or for those bamboos which are found gregariously in one or two divisions only? From the day the Forest Officer enters Burma he is taught, unintentionally no doubt, but none the less surely, to look upon the *kyathaungwa* as a thing apart, instead of merely as one of a kind, with the result that numberless opportunities for studying by actual experiment the effects of different methods of treatment in areas of flowered bamboo have been lost, frequently without comment. Let us then cease this endless writing about the flowering of kyathaung and accustom ourselves to think about the flowering of the *bamboo*; let us evolve some scheme of work for the reproduction of teak in flowered bamboo areas which will become as much or even more a part of the routine work of the Forest Officer as fire-protection or the preparation of working-plans."

* * * * * *

Thittaw-Wunmin.

I don't know who "Thittaw-Wunmin" is, but I am none the less pleased to come across his article because it affords confirmation to the very same opinion that I had already formed myself. The *tin* in Pyinmana is a case in point. It has flowered all over the place, and fire-protection has enabled it to choke off all teak regeneration, and yet we have made absolutely no attempt to tackle it or to experiment with it. All I can find is a string of elaborate proposals for experiments with it *in order to be beforehand with the flowering of kyathaung*. These experiments never came off. We have sold our birth right and got nothing for it; all because the deal was with the modest and unassuming *tin* instead of with the much vaunted *kyathaung*.

Further, a good deal of the *wathon* which I took at first to be *tin* is really *wannwe* (*Oxytenanthera albociliata*); a species for which I have never heard of any plans being made although it is worse than the big species where it exists. And there are many others. "Thittaw-Wunmin" is quite right. Our schemes must include and apply to all kinds of bamboos. It is not safe to leave out any of them.

9. The depreciation of the *tin* is largely due to its close association with the *kyathaung*. In point of size the *kyathaung* with its 90 feet stems of 15 inches girth does tower over the little *tin*, which cannot rise beyond 70 feet by 10 inches and does not average more than 60 feet by 9 inches.

Another reason why *tin* has attracted so little attention is that, years ago, the idea was started that it flowered sporadically. Brandis in "Indian Trees" divides bamboos into three classes according to flowering, *viz*: (1) annual; (2) periodic and gregarious; (3) irregular or sporadic. *Kyathaung* is given as an example of the second class; *tin* and *wannwe* of the third class.

The following references to the flowering of *tin* are taken from Circle annual reports for the past 20 years :—

1892-93	...	Tharrawaddy	...	5 years before in Kon-Bilin.
1894-95	...	Ruby Mines	...	15 years before in the Shwele.
		Lower Chindwin	...	Sporadic flowering.
1896-97	...	Ruby mines	...	Sporadic flowering in Nanpaw.

1900-01 ...	Myittha ...	Flowering in Taungdwin.
1900-05 ...	Upper Chindwin ...	Extensive flowering in the past few years.
1905-06 ...	Do. do. Myittha Katha } ...	Universal flowering.
1906-07 ...	Toungoo ...	Gregarious flowering in Gwethe and Kabaung.
1906-07 ...	Pyinmana ...	Gregarious flowering over a large area.
1906-07 ...	Northern Circle ...	"The *tinwa*, the chief associate of teak in Upper Burma, apparently began flowering in the northern part of the Upper Chindwin Division in 1902 and the flowering has been gradually advancing southwards and eastwards. In 1905-06 it had reached the northern reserves of the Myittha and Katha Divisions and is reported as now occurring in some of the reserves in the Mu Division."
1907-08 ...	Northern Circle ...	"A wave of the flowering of *tinwa* which has been advancing over Upper Burma during the past 4 or 5 years."
1908-09 ...	Henzada ...	Gregarious flowering.
1910-11 ...	Shwegyin ...	Sporadic flowering of young *tin* 3 or 4 years old ; seed infertile.
1910-11 ...	Northern Circle ...	General flowering of bamboos in the Upper Chindwin ; species not stated.

The above extracts certainly justify the placing of the *tin* bamboo in Brandis' second class.

10. The following extract is taken from page 662 of "Indian Trees":—

"When, after the flowering of bamboos in a certain district the fires of the hot season have swept away the tangled mass of dry stems, the next rainy season produces millions of seedling bamboos, which soon grow up into slender plants 2-3 feet high, forming dense waving green masses on the ground. Among these millions of plants the stronger gradually get the upper hand, and these in course of time develop into those remarkable rhizomes, consisting in tufted species of innumerable stout twisting and interlaced branches, which produce the leaf-bearing culms. The

development of bamboo seedlings into a clump is a most remarkable process, which has not yet been sufficiently studied—(of. Brandis, in *Indian Forester*, XXV. 4). Nor has it yet been ascertained how many years a seedling requires to form a clump consisting of full-sized stems. In the case of *Bambusa polymorpha* and *arundinacea* the period is probably between 8 and 12 years. Offsets from mature clumps produce full-sized culms in 2 or 3 years.

In the case of *tin*, I can add my quota to the above by saying that under the most favourable conditions it takes from 12 to 15 years to produce full-sized stems and that under unfavourable conditions the time required may be anything up to 30 years or more—(see para. 20).

11. The foregoing remarks are sufficient to convince anyone that *tin* plays a very important part in the teak forests of Burma. I wish now to go into details as to the conditions under which it exists in one division—Pyinmana.

There are no less than 9 working-plans. A start was made in 1896 at the southern end, with the Yeni Reserve. Working gradually northwards, through the Minbyin, Yonbin, Palwe, Kaing, Yanaung Myin, Ngalaik, Pozaungdaung and Taungnyo forests, plans for the reserves on the Pegu Yomas ended with the Sinthe one in 1902. In 1903 a plan for two small patches of forests (Mehaw and Ziyaing) in the hills east of the railway was drawn up.

In the working-plans are the following references to the flowering of *tin* bamboo :—

Yeni, 1897.—"*Tin wathon* occurs everywhere where the cover of the older bamboos is sufficiently open to allow of its growth."

It is mentioned in the descriptions of five compartments.

Minbyin, 1892.—"There is often a dense growth of *tin wathon* which interferes considerably with reproduction and which, together with the heavy shade of *kyathaung* is the cause of the smaller classes of teak being less well represented in the moist forest than in other and drier portions."

Wathon is mentioned in the descriptions of 38 compartments out of 126.

Yonbin	... 1899	... No references.
Palwe	... 1899	... Recent flowering mentioned in 8 compartments, *wathon* referred to in 2 others.
Ngalaik	... 1900	... Recent flowering mentioned in 3 compartments.
Taungnyo	... 1901	... One year old *wathon* in 2 compartments.
Pozaungdaung	1901	... Recent gregarious flowering in 6 compartments.
Sinthe	... 1902	... (Dry forests, no *tin* bamboo).
Mehaw	... 1903	... No references.

The dates given above denote the years in which the field work was started. In most cases it was completed or nearly so in one season. 1897 means 1896-97.

As Toungoo is next door to Pyinmana, and only separated from it by an artificial line, the old frontier line, it is worth while mentioning here that the occurrence of *tin wathon* is mentioned in all the plans for forests west of the railway (Pegu Yomas). These plans were completed between 1892 and 1901.

12. A certain amount of caution should be exercised in using these extracts. The absence of any reference to *wathon* in a compartment must not be taken to mean that *wathon* did not exist there when the plan was written. In some cases it may not have existed or may not have been noticed; in others the omission of this detail from the stock descriptions escaped notice. If you do not set out with the idea of specially noting on any particular point, it often passes unnoted altogether. For example :—Two years ago I spent some days in looking at girdling in Minbyin, without being at all struck with *tin wathon*; this year it dwarfs everything else.

There is also a good deal of ambiguity about the use of the terms "reproduction" and "regeneration." The terms ought to be restricted to seedlings and small saplings; but I have come across instances where, on questioning the writers, I found they had poles in mind more than anything. Again, as to the use of the terms "good", "fair," "bad," etc., it is easy to convey wrong impressions by using definite terms in describing general observations. It takes time to take in everything. In an uneven

aged and mixed forest it is not easy to decide what class of any species is deficient or absent. As nobody knows the rate of mortality it is not easy to say whether any class is sufficiently well represented to keep up to the level of the next above it.

13. Protection from fire began in Pyinmana as follows :—

1892	... Vanaungmyin.	1900	... Minbyin.
1894	... Kaing.	1902	... Yonbin.
1897	... Yeni.	1904	Taungnyo. and Ngalaik.
1899	... Palwe.		

In 1907, half Kaing was thrown out, and in 1912 the balance (except young plantations).

The expenditure on protection in the 10 years ending with 1910-11 amounted to Rs. 1,30,161, or about Rs. 13,000 a year.

14. Two inhabitants of Chaungwa, a village in the middle of the Minbyin Reserve, recently told me that they distinctly remembered the flowering of the *tin*, and that it took place all over the southern part of the reserve two years before the Annexation, that is, in 1882. They said the flowering was general. In reply, however, to further questions they said it might have taken place later in the northern half, but that all was over within about 10 years.

NOTE.—The two old men I talked to said their ages were 56 and 60, and they both said they remembered a general flowering of *kyathaung* in B. E. 1231, *i.e*, 1870 or 42 years ago.

If their statements are to be believed the *tin wathon* in South Minbyin is now 30 years old, and it was 15 years old when Mr. S. Carr wrote the working-plan.

In several compartments Mr. Carr referred to the *wathon* as being very tall and dense. Bearing in mind the fact that protection from fire had not then been started, and from what I have seen of young *tin* of known age elsewhere, I am certainly of opinion that the young *tin* in Minbyin does date about from 25 to 30 years.

15. The absence of all references to *wathon* in the Yonbin Working Plan (1899) is remarkable. It is mentioned in Palwe (1899). Yonbin comes between this forest and Minbyin. When girdling was done in Yonbin in 1900 dense *wathon* of several years' growth was very much in evidence. Villagers have told me

that they distinctly remember the flowering about 15 years ago, when Mr. Muriel was D. F. O. This would be about 1897, or just before the working-plan was made. The Manager, Messrs. B. B. T. Corporation, puts the date 3 years later. He has recently told me that he was in Yonbin in 1900 and distinctly remembered telling the D. F. O., Mr. H. Carter, of general flowering that year. I infer therefore that here as elsewhere the flowering was spread over a number of years.

16. The course of the *tin* flowering appears to have been somewhat as follows :—30 years ago it was general in Toungoo, and also in the adjacent parts of Pyinmana (Yeni, Minbyin). In the next ten years it made very little progress. 15 years ago it reached Yonbin, and, within the next 5 years, it spread all over the rest of the *tin* bearing areas west of the railway, the business being completed last of all in the Yanaungmyin, Pozaungdaung and Kaing blocks in 1908. East of the railway *wathon* is now very conspicuous in Mehaw and is also said to date from the same year. Flowering in the adjoining forests of Gwethe, is mentioned in the Toungoo Annual Report for 1906-07.

It must not, however, be supposed that the flowering was limited to the years named.

Flowering of any species of bamboo should be looked upon as dividing itself into three stages: 1st sporadic flowering of odd clumps in advance, increasing in volume until the 2nd stage of gregarious flowering is reached, and then tailing off to sporadic flowering of odd belated clumps as the 3rd and last stage. There are great variations in the lengths of and relative proportions between these stages. With *tin* the shortest times are a year apiece, or 3 years for the whole business. On the other hand in some places I have no doubt the 1st and 3rd stages are so very much more prolonged that the 2nd may be neglected or escape notice altogether.

17. Go where you will in the unprotected *wathon* forests in Pyinmana, one feature is noticeable—the bamboo has a hard struggle for supremacy. The longer the interval since the flowering the greater the variations. Locality and season have a lot to say in

the matter. Fires vary in intensity from place to place, and from year to year in the same place. In a wet year such as 1910, in lots of places there is no burning at all. The younger the bamboo growth, the more it benefits from such favourable conditions. In Mehaw the 4-year old *wathon* is now locally a dense mass 6 to 8 feet high in which a man cannot be seen ten yards off. In other places it is an open low growth in which a man would have to lie down to hide himself. It is a remarkable fact and yet true that the age of *wathon* in unprotected forest cannot be judged by its size. It may be anything from 2 to 20 years or more. The opposite sides of any of the external fire-lines in Pyinmana can furnish examples of this. On the outside the *wathon* is often so low and open that its very existence as *wathon* passes unnoticed. On the inside right up to the very edge of the fire line is a dense mass of *wathon* 20 to 30 feet high in which an elephant would be lost at ten paces distance.

18. The differences between the *wathon* with and without protection are no more striking than the differences between the teak regeneration in them. In the open type of suppressed *wathon* all stages can be found from the small seedling to the stout sapling; patchy and deficient in many places it is true, but at any rate giving rise to a reasonable hope that the teak will hold its own. And on the other side, what is the state of affairs? *Most of the teak regeneration that existed at the time the protection from fire was started has been absolutely wiped out and no more has been able to establish itself.* The Minbyin Reserve can give plenty of examples. Let me refer to the 1st and 2nd sub-periodic blocks—51 compartments.

The Working-plan Officer in 1897 described teak reproduction in them as—excellent, 15; very good, 7; good, 18; fair, 9; poor, 2. 38 of these compartments have been under protection for 10 to 15 years, and in them it is now only the places without any bamboos at all, or with big *kyathaung*, which save them from being booked as practically devoid of any teak regeneration at all. Alongside dragging paths and other openings you may find a little, but nowhere else. Cs. 27, 28 and 35 in which I spent two

days are enough to sicken anybody. They are hard to beat I am sure. This is what Mr. S. Carr wrote about them in 1897 :—

C. 27.—"...........*tin wathon* is common and in places very dense. On the ridges and slopes teak is very plentiful and large trees are numerous.........Reproduction is good on the whole, but seedlings are irregularly distributed. The dense bamboo cover (both young and old) in many places prevents their development."

C. 28—Like C. 27.

C. 35.—"...... *tin wathon* is almost universally distributed and is often very dense.........Reproduction is good."

When girdling was done in Cs. 27 and 28 in 1903 the Girdling Officer remarked on the absence of the seedling class.

What do these compartments look like now in 1912? First class bamboo plantations! Potential paper-pulp! I went to look especially for teak seedlings and saplings. I walked for two hours along the main ridge in C. 27 without seeing a single one. I made no enumerations, but estimate that I saw far more trees over 5 feet than under. I was constantly pulling up before the mournful spectacle of big trees left by the Girdling Officer in 1903 for seed. What a wretched waste! How many tons of seed have been shed by them in vain!

Two enumerations have been made this year: 240 acres in C. 35 (dense *wathon* except on the tops of spurs and in ravines); 300 acres in C. 95 (not protected; big *kyathaung* with a little suppressed *wathon*). The results per 100 acres are—

—			C. 35.	C. 95.
Under 6″ girth.	Under 4′ 6″ height.	New ...	...	4
		Old ...	23	290
	Over 4′ 6″ height		40	76
6″ to 8″ girth			10	18
9″ to 11″ girth			10	28

"New" seedlings are those with no old root stock visible.

The 23 "old" seedlings in C. 35 are the last survivals of what Mr. Carr called good reproduction 13 years ago. All these and the 40 over 4′ 6″ high are outside the *wathon*. There are absolutely none inside.

19. Examples such as the above could be multiplied indefinitely in all the reserves in which fire-protection has been the order of the day. They prove conclusively that the teak is nothing like so well off now as it was 10 to 15 years ago. The luxuriant growth of the young bamboos owing to the protection from fire is the only assignable cause for the change.

NOTE.—*If additional weight to the argument is wanted before putting a period to* protection, the best plan would be to ask the officers who wrote the working-plans to come and revisit them for a week or two. It would be miles cheaper in the end.

20. A subject which has not yet been discussed is the time required for seedling bamboos to become full-sized. My observations go to show that the period for *tin* is longer than commonly supposed—(*vide* para. 10).

The following are examples of *tin wathon* which has grown up more or less under protection:—

(*a*) *Yanaungmyin.*—Flowering took place in 1908. No fires since then. In the most advanced places the average height of the main mass of the *wathon* is now (1912) only about 5 feet and the biggest stems are not more than about 2″ in girth at breast height. No fires have occurred in the interval.

(*b*) *Kaing.*—Protected since 1893-94 and flowering about 1898 to 1900. Three-quarters of the reserve is now covered with a dense growth of *wathon* from 15 to 30 feet high and up to 5″ in girth. Stems of more than six inches are very rare. Thinning out of the stems has made considerable progress in the past 12 to 14 years, but the stems have not yet made much progress towards sorting themselves into well-defined clumps. It is a slow business walking about without clearing away with a *dah*.

(*c*) *Yonbin.*—Protected since 1902 flowering about 1897.

The *wathon* is very much the same as in Minbyin described below. The largest stems run to 70′ by 10″.

(*d*) *Minbyin.*—Protection began in 1900; flowering took place about 1882 (para. 14).

The thinning out into distinct clumps is complete in places, although the clumps are still far more numerous than in old *tin*, and the clumps still retain their characteristic appearance of *wathon*. The average height is well over 30 feet, and the biggest stems are 50 to 70 feet by 8″ to 9″ girth. *It is only the recently formed stems that are this size.* In all clumps, the stems are of all sizes down to small sticks. In clumps of undoubtedly old *tin*, which are to be met with here and there, I have not been able to find any stem of more than 70 feet by 9″.

From the Yonbin *wathon* it may be inferred that it takes from 12 to 15 years for the development of full-sized stems under the most favourable conditions. The Minbyin *wathon* shows that under unfavourable conditions the period can be extended very considerably.

The variations caused by the 15 years' interval without protection in Minbyin are very great. In some parts of C. 35 the biggest stems do not exceed 32 feet by 4″. Elsewhere they run to 6″. In C. 103 unprotected stems of 60 feet by 9″ are to be met with.

21. A thorough grasp of the fact that it takes bamboos so many years to come to maturity, under the most favourable conditions for their rapid development, leads to a whole train of reflections. The great length of the periods between flowering (40 to 50 years) no longer seems so extraordinary. It also remains to be seen whether the periods will not be appreciably shortened by protection. The flowering is certainly likely to be far more gregarious than under natural conditions. These are forces to be reckoned with in any proposals for regulating fires in the future. It would be worth while sacrificing a lot of

regeneration (by protection), or a lot of standing or fallen timber (by burning), if the principal bamboos could be induced to flower block by block as we wanted them to. The *kyathaung* bogey is not dead. It may yet be a veritable nightmare to many of us.

III.—Suggestions.

22. It is to be hoped that a full account of the experiments carried out in the Northern Circle during the past five years will soon be published. The remarks in annual reports are not enough to enable an outsider to follow the course of the experiments closely.

In his Annual Review for 1907-08 Mr. Lace remarked that the burning over of flowered *tin* or *myin* areas in Katha had shown that sufficient teak can be established over extensive areas at a comparatively small cost; and that artificial sowing is not as a rule necessary. All that need be done is to burn the areas for one or more years according to the time taken to burn the dead culms thoroughly, and, after the last burning, to cut back all injured or badly grown teak saplings and small poles, such operations being followed by such periodic cleanings and improvement fellings as experience shows to be necessary.

These remarks are definite enough. It is not easy to understand why they have not been circularised as a working basis in all circles and in all divisions where *tin* and *myin* prevail. Rs. 40,000 in the interval spent on protection in Pyinmana alone—mostly wasted.

23. Never having seen gregarious flowering of any bamboo myself there is a lot for me to learn of the practical details. Most junior officers are in much the same position.

(*i*) Is there any means of telling beforehand when to expect a general flowering other than the advance flowering of odd clumps referred to in para. 16?

(*ii*) How long does it take for the dead stems to dry up and fall over with or without the help of fire?

(*iii*) What happens to the root-stocks, and how long do they take to disappear with or without the help of fire?

(*iv*) What burning is necessary to get rid of the dead stems ?

24. It may be unintentional but later annual reports rather give the impression that fires are still to be kept very much at arm's length. "Abandonment is only sanctioned as a temporary measure for 3 years" dosen't sound very hopeful. If two and two do make four "protection" ought by this time to be looked upon as the temporary measure.

A loud note of warning is necessary. *In flowered bamboo areas there is no turning back once you have started protection.* This may seem to many a ridiculous exaggeration; but it is nothing of the sort. After a few years' protection the bamboos scoff at fires and decline to bow to anything but the *dah.* The Kaing Reserve (para. 20) is an excellent (or rather deplorable) example. Fires alone will make no appreciable impression on the dense mass of bamboos 15 to 30 feet high. Short of waiting until the next flowering for further teak regeneration, there is nothing for it but to cut down the bamboos wholesale. In 19 years a sum of Rs. 19,272 has been spent on protection in Kaing. To put the clock back and leave the forest *as it was before protection began* would cost at least Rs. 10,000 more. The case must be exactly similar in all *wathon* areas. Without exception therefore the rule should be :—

In flowered bamboo forests protection should be strictly limited to such areas as can be adequately attended to afterwards.

It is admitted on all hands that the state of a forest after protection, without sylvicultural operations, is worse than before. If you can only manage 10 square miles of cleanings and improvement fellings a year it is worse than useless to protect more. Let the rest wait till you are ready. Give fire half a chance and it will make the *wathon* mark time. After all, it must not be forgotten that our interference at all with the ordinary course of things is solely with a view to increasing the proportion of teak. There is no getting away from the fact that the teak can hold its own if the forest is left alone.

25. The results of actual experiments in the Northern Circle, when published, ought to settle once for all what is the best way

of treating recently flowered areas. It may be taken as fairly certain (para. 22) that the cost of the sylvicultural operations to start regeneration in them on a satisfactory basis need not as a rule be great. The very big question however still remains to be answered : what about older *wathon* areas where, owing to protection or other causes, the bamboos have got the upper hand ?

Here it is a case of teak regeneration being literally choked off and, if the hiatus is not to extend up to the next flowering, the bamboos must be got rid of, and this will not be an inexpensive business.

It cannot be too strongly emphasised that improvement fellings, in the ordinary sense of the term, are absolutely useless. Kept in their place for the helping on of saplings and poles, they are right enough. To speak of them in connection with regeneration is hopeless and misleading, unless they connote the wholesale cutting back of bamboos. In practice this is exactly what they do not mean, for they leave bamboos severely alone.

I have recently inspected some improvement fellings which cost about Rs. 2 an acre. They are quite good in their way and will help on saplings and poles very considerably. Additional regeneration was not aimed at, and so they leave absolutely untouched all the places where the big bamboos predominate, amounting to far more than half the total area of the compartment. This example is typical of nearly all improvement fellings in Burma. Bamboos predominate in the vast majority of the forests. It must be confessed therefore that our much talked of Improvement fellings do not and never will count for much in respect to regeneration. They look well on paper, and that is about all there is to be said for them.

26. Fire alone will not get rid of bamboos. They must be cut first. There are two ways of doing this—departmentally or through the agency of the taungya cutter. The choice depends to some extent on the object aimed at. If the uneven-aged character of natural teak forests is to be preserved, then the areas operated upon must be very small, and taungya cutters

could not be induced to work them. If plots of an acre or more are not objected to, then there is no reason why any departmental cutting on a large scale need be resorted to.

I am a great believer in taungya plantations. They are out and out the cheapest way of creating a teak forest of any desired density in heavy bamboo growth. As the choice of locality and density of the final crop are quite under the control of the Forest Officer (provided that he sticks to areas suitable for teak), it seems to me that a forester could desire nothing better. He can have any kinds he likes; large plantations or small ones; pure teak or a mixture. He can please himself how much of the natural forest he leaves untouched. All that is essential to success is that he has some method about extensions and subsequent cultural operations.

An objection to plantations is the cost of creation and subsequent treatment. They may be expensive, but men who make the objection are apt to forget that the final yield from a plantation will be anything up to a hundred times as much as from ordinary teak forest. You cannot get anything worth having this world for nothing.

In respect to plantations we are as conservative as we are with fire-protection. Line sowing at Rs. 10 an acre is still the rule. Minbu is the only division I have heard of (other than the *wathon* sowings in the Northern Circle) in which broadcast sowing is done. I have tried it myself in Pyinmana with great success. In the 1910 plantations I did half in lines at Rs. 10 and half broadcast at about Rs. 2 an acre. In January last I found one quite as good as the other. If anything the best patches in the broadcast were a little better (13 feet high) than in the line sown portion. On steep slopes seed gets washed away and dibbling in lines is better; on gentle slopes and flat ground the broadcast is superior. More seed is wanted for the broadcast method, but as seed is not a big item this does not matter much.

This article is not concerned with the *pros* and *cons* of taungya plantations from a financial point of view. My sole reason for mentioning them is because they are one way of retracing our

steps, covering up the traces of our past mistakes, defeating the ubiquitous bamboo and enriching the forest with teak. If the remarks made in the next paragraph are borne in mind, I think it will be admitted that plantations could be run on a scale commensurate with our need for them.

27. Notwithstanding the magnitude and variety of the proposals that have been put forward from time to time for the improvement of the forests in Burma, I have never come across any reference to the question as to whether we want to improve *all the forests.* It has been taken for granted that measures for protection and improvement should be co-extensive with the reserves themselves. Is this a sound policy? If we could multiply the supply of teak twenty-fold or fifty-fold or a hundred-fold would the market absorb it all? I rather doubt it. Anyway the attempt to deal with such vast areas has crippled our energies very considerably. Nothing is voted as of any practical value unless it can be thought about in hundreds of square miles. We are in consequence reduced to doing next to nothing. I forget whether the subject was raised at the Maymyo Conference (1910). Anyway it does not appear in Mr. Troup's amended memorandum, under which all forests in a given locality are included in one working circle.

It seems to me that it would be far better to set out with the idea that, the more we can increase the productiveness of a portion of the total area, the smaller that portion may be. If the productiveness of one-fifth be increased ten-fold, we would double the present yield whilst leaving four-fifths to look after itself. This would certainly be a good working basis for a single generation. Following up this idea I would abolish all our piecemeal working-plans, and I would bring into one working circle all the localities which are best suited for the growth of teak up to one-fifth of the divisional total. Outside I would have selection fellings and, if you like, such simple operations as creeper cutting, *nyaungbat* felling, etc., but no fire-protection except of girdled trees and fellings. Inside I would lay myself out to get the ten-fold yield. If I did not succeed my successors

could take in more from outside. They would be no worse off than we are now. *What a difference this plan would make in* our outlook! The dread *kyathaung* would be robbed of much of its terrors, if we knew that we need not worry about it in four blocks out of five!

28. The foregoing remarks will, it is hoped, have brought out the necessity for taking the flowering of bamboos as the pivot on which to hinge all schemes for improvement of the forests, with teak regeneration as the main objective.

There is only one step further to which I wish to carry the argument. If our sylvicultural operations ought to hang on the flowering of bamboos, why should not our method of exploitation do so likewise? It ought to do so.

At present we have an endless series of arbitrarily chosen felling rotations varying from 20 to 40 years. How much more scientific it would be to set out with the idea of regulating all our operations by the flowering cycles of the bamboos which exert such a predominating influence in the forests.

Proposals for introducing the uniform system into Burma have come into being within the past few years. The flowering of bamboos puts practical limits to the conversion from the selection system. Instead of aiming at regeneration once in 150 years in a given locality, we should recognise the fact that nature provides us with excellent regeneration at special times once every 30 to 50 years. If we aim at making the most use of this we will end with a sort of three storied forest. We will not however want to do all the regeneration in a year or two over a whole working circle with none in the intervals. But we can with the help of fire hold back the *wathon* to suit our own convenience and thus enable us to deal with individual compartments one after the other, and to spread the regeneration of a whole block over the flowering cycle of, say, 50 years. There is some conflict between the view here expressed and that advocated in para. 26. Three-storied taungya plantations won't work. A plantation means regeneration which does not require to be supplemented or renewed for, say, 100 to 150 years. There is no room for extra,

teak in the next bamboo flowering cycle. This is true enough, and yet there need be no overlapping. I would limit taungya plantations to areas where bamboos are big or where *wathon* is out of hand. Wherever there is a reasonable hope of success in young *wathon* areas I would trust to fires and natural regeneration (para. 22).

29. At the Maymyo Conference in 1910 the idea was put forward and accepted that any desired degree of teak regeneration could be obtained by intense improvement fellings several times repeated. Nothing was said about the flowering of bamboos and the impression conveyed was that you might start the operations when and where you pleased. If the arguments advanced in this paper are sound this is very far from being the case. The natural time for beginning cultural operations aiming at regeneration is with the flowering of the bamboos. Operations at any other time may be looked upon eith r trying to make up for lost time or as trying to forestall nature, according as the last flowering is nearer or further off than the next one to be expected in the future. In either case the expense is bound to be greater than if there is co-ordination with nature.

30. It is impossible to travel far in the unprotected forests in Pyinmana without being struck with the fact that there is a great disproportion between the numbers of small seedlings and saplings of teak. This is well shown in linear surveys in which stems under 6 inches in girth are divided into two classes according as less or more than 4'6" high (para. 18). It is well known that seedlings get burnt back year after year. Eventually some get above the danger zone and shoot ahead.

Two years ago I suggested to the Conservator, Mr. E. S. Carr, that protection for short periods could not but help to improve matters. The proposal I then made was shelved. I still think that there is something in the idea. Inasmuch however as *wathon* is so widely distributed, the chances are that we would do as much harm to regeneration in one place (by favouring the bamboo) as we would do good to timber in another, unless prepared to step in with cultural operations. In the four-fifths of the division which

would come outside the working circle of intense operations (para. 27), I would therefore limit protection to girdling or felling areas discussed in the next paragraph.

31. So far I have only touched on the use of fire as an aid to teak regeneration. What about the damage to standing trees and timber? This cannot be denied and ought not to be belittled. It ought to be reduced as much as possible. Each forest should be dealt with on its own merits, a start could be made anywhere for standing timber needs protection everywhere. Selection is however possible, and, for a start I would make it a rule to first of all protect girdled trees until fellings were completed. This would rarely be for more than five years, and three would generally be sufficient. Another useful expedient would be to prohibit felling and logging after 15th February. This is done in protected areas but not outside.

As regeneration is all that has hitherto been thought about in respect to the selection of areas for protection, to base the latter on girdling or felling areas would mean a total re-arrangement of the protective measures. In Pyinmana it would mean the giving up of protection in about 270 square miles and the starting of it in another 100 square miles. It would reduce the total area under protection (and the bill) to half. But not more, and so, before committing ourselves to even this much at present, the opening remarks in this paper about the financial position of the province ought to be considered.

Protection from fire of standing timber is only one of many possible measures of improvement. It has no right to claim precedence over climber cutting, *nyaungbat* felling, roads and buildings, wells, etc., and the various other ways in which the forests and their exploitation can be improved. We ought to get rid of the idea that everything must play second fiddle to protection. Given unlimited funds it does not matter. With a budget cut down almost to a vanishing point it is a matter of considerable importance. For example, to protect all girdling areas in Pyinmana Rs. 6,000 a year will be required. For the next few years, at any rate, I venture to think that Rs. 4,000 of

this could be more usefully spent on buildings and wells, to say nothing of roads and creepers. As soon as the lean years are over protection can be extended.

32. It may be urged that the conclusions arrived at in this essay are of very little practical value, seeing that they only take account of one set of conditions, whereas the forests of Burma present the bewildering spectacle of an almost endless variety of different conditions. It is quite true that *tin* is only one bamboo amongst many; that it does not even exist at all in many forests; and that there are other things to be thought of besides regeneration. Still, I believe that considerable progress towards understanding how to deal with all bamboos can be made by getting a thorough grasp of the way to tackle one of them. I would go a step further. I believe that the same method of treatment is likely to suit all. I do not think that the distinction between the moist and dry types is so great as is generally supposed in respect to teak regeneration.

We lose very considerably by our habit of thinking of only one thing at a time. Teak girdling, pyingado fellings, unreserved fellings, and cultural operations are all more or less run independently. If they do happen to hit it off together in one place, it is more by accident than by design. It is about time that a move was made towards something a little less primitive. Heaps of examples can be found in divisions like Pyinmana. Here is one. The improvement fellings referred to in para. 25 are in Yanaungmyin C. 6. This compartment contains big *kyathaung*, young *tin wathon*, dead *wannwe* which flowered last year, and *thaik* bamboo (*B. tulda*) now in flower. Heavy pyingado fellings took place some years ago. It contains a good deal of big teak mostly unsound. In the working-plan everything was subordinated to planning for a steady outturn of sound teak in the near future, and so the compartments with the largest percentage of unsound timber in them are to be left until last, whereas a sylviculturist would have put them first. At the moment, however, I am not so much concerned with this. I only want to try and show how much more could be done in the way of cultural operations by a

little more looking ahead. The improvement fellings leave more than half the compartment untouched. They don't affect the bamboos. This is the very part I should have liked to have seen tackled this year. There is room for natural regeneration with the help of fire in the suppressed *wathon* and flowering areas and for artificial regeneration by means of *taungyas*, in the big bamboo and dense *wathon* areas. Taken in hand simultaneously the whole lot could be managed and none need be overlooked. Left for the future they become an impossibility. The nett result therefore is that instead of multiplying the productiveness *of the whole area* by ten we are satisfied with a possible doubling of it in half the area.

It may also be urged that the conclusions arrived at in this essay are too sweeping and misleading; that *tin* is not the only bamboo in Burma and in many places there are no bamboos at all, and so the beautiful simplicity of my rotations based on flowering cycles is very much visionary. It is true I have only carried on the argument for one species of bamboo, but I believe it can be applied to all. The indiscriminate protection of all types of teak forest hitherto in vogue has produced such a crop of negative results, and the enormous size of our forests has seemed to do nothing but raise a laugh at our expense for the smallness of the impression made on them by half a century of Forest Officers. Am I deluding myself with a vain hope in thinking that the bamboos themselves hold the key, and that we may yet see daylight within the next few years?

PYINMANA: F. A. LEETE,
26th April 1912. I.F.S.

A PLEA FOR ECONOMIC FORESTRY.

Mr. Jerram's letter in the June *Indian Forester* on my article on the above subject affords me an opportunity of explaining more fully one direction in which I feel convinced Indian forestry is in need of early investigation.

Mr. Jerram is correct when he understands me to be an advocate of a financial rotation. I say purposely "a" financial

rotation, as I fully appreciate we are not yet in a position to calculate the financial rotation for Indian forests with the minuteness it is done on the continent of Europe. Mr. Jerram objects to a financial rotation for two reasons :—

(*a*) that trees must be large enough to yield, say, sleepers with a minimum of waste, and

(*b*) that trees must not be so large as to be liable to excessive damage in felling.

Under (*a*) I gather he means by "minimum of waste" a reasonable proportion of waste. If that is so I agree with these requirements. Indeed in my original article I stated that the rotation must be such as will yield the most useful produce. Again these requirements are provided for in my proposals to base the calculations on the value of the actual outturn. For, if sleepers are the most profitable form of timber, the value of the outturn will rise considerably at that rotation at which trees will yield sleepers, and again proportionately as the wastage decreases whether it be in felling or sawing.

The trouble is, as Mr. Jerram suggests, that the limits imposed by a consideration of wastage alone are very wide indeed.

Mr. Jerram then proposes that the rotation within these limits should be fixed to correspond with the culmination of the mean annual (timber) volume increment of a tree. He says if necessary account should be taken of value increment too, and later he expresses some doubt as to the value of deodar sapwood. Although in this latter matter I would go even further than Mr. Jerram and definitely say that deodar sapwood should be treated as valueless, yet otherwise I do not think the Indian timber market discriminates as to quality of deodar timber relative to age.

Mr. Jerram claims that the method he proposes obviates the necessity of fixing a minimum rate of interest to be required of the forest. This it certainly does, but at the same time the culmination of the mean annual increment is not sufficiently definite to determine the best rotation with any accuracy. A reference to European Yield tables will show the mean annual increment *for a crop of* 1 *acre* lies as a rule within 5 c.ft. for 50 years or so.

Apart from this, the culmination of the mean annual increment of individual trees does not coincide with that of crops, but will be much later. For the number of trees per acre must diminish with increasing age and this means that while the mean annual increment of a crop is rising a small number of trees is able to put on a larger increment than the previously greater number of trees. Much more so then must the diminishing number of trees be increasing their own previous mean annual increment.

The following figures from a Scotch Pine Yield table of the II quality will illustrate this :—

Age.	Number of trees on 1 acre.	Volume of timber on 1 acre.	* Mean annual increment of crop, final yield only.	* Mean annual increment of average tree.	Remarks.
		c. ft.	c. ft.	c. ft.	
50	760	2,820	56	·08	* Disregarding intermediate yield in previous years.
70	440	3,970	57	·13	
90	300	4,740	53	·18	
110	220	5,340	49	·22	
130	180	5,860	45	·25	

From the above it will be seen that Mr. Jerram's method would lead to a rotation of 130 years or even more, for I have taken no account of increase in value. And there is every probability the value would be rising beyond 130 years if for no other reason than that the proportion of wastage in conversion would be falling. Correctly calculated, in this case the rotation of the highest mean annual timber increment of the crop and the financial rotation fall at about the 80th year.

Mr. Jerram's objections to my suggestion are that not only like his method must it be based on single trees, but that it involves the fixing of a rate of interest.

I admit that it is not altogether satisfactory to have to base the calculations on statistics for single trees, but I do not think want of better data warrants neglect of all proper consideration of the financial results obtained. It is true that as shown above Mr. Jerram's calculations based on single trees are useless, but

the same argument does not apply to the method I suggested. I will illustrate this by the following figures for a deodar tree :—

Age.	Volume of timber.	Mean annual increment.	Value of unit of timber.	Value of tree.	Rate of compound interest yielded by tree.
	c. ft.	c. ft.	Rs. a.	Rs.	
100	50	·50	0 8	25	2·4%
120	80	·66	0 8	40	1·1%
150	110	·73	0 8	55	

Mr. Jerram would accordingly fix the rotation at 150 years or more, but the rate of interest the tree is developing shows that the rotation cannot be prolonged beyond 120 years without considerable sacrifice.

Applying the same calculation to the figures given in a European Spruce Yield table, 2nd quality, the following results are obtained :—

Age.	Final yield.	Intermediate yield if rotation prolonged.	Crop retained if rotation prolonged.	Rate of compound interest developed.
	Rs. per acre.	Rs. per acre.	Rs. per acre.	Per cent.
30	262	23	239	9·8
40	611	69	542	7·5
50	1,115	121	994	5·8
60	1,749	198	1,551	4·3
70	2,359	286	2,073	3·6
80	2,942	355	2,587	2·7
90	3,372	411	2,961	2·2
100	3,668	449	3,219	1·8
110	3,844	459	3,385	1·4
120	3,889	431	3,458	

[NOTE. Here the rate of interest is calculated on the yield per acre but after the intermediate yield has been removed, so that it may fairly be taken to apply to the average individual tree.]

It is seen from the above that, given a minimum technical rotation of 70—80 years, in prolonging the rotation beyond 80 years an even greater sacrifice is made than in prolonging it from 70 to 80 years. And beyond 90 years the rate of interest (2·2 per cent) can in the circumstances scarcely be considered adequate. I have left intermediate yield out of consideration in my calculation. This will generally be necessary in India as satisfactory figures for the comparison of the yield of crops are seldom available; and since revenue from intermediate yield can always be invested in enterprises other than forestry to give equally good returns the omission is of little consequence.

As regards Mr. Jerram's second objection it will be seen that I do not propose to fix any minimum rate of interest which must always be required. I propose to investigate the rate of compound interest at which trees are progressing and to let the results *determine an economic rotation* suitable to the particular circumstances.

I am sorry Mr. Jerram does not quote the many objections he finds to my proposal, so that I might deal with them. As to his statement that I would reduce the rotation below that of the greatest yield, I can only point out again that he has given no practical means of determining the rotation of the maximum mean annual increment of crops with sufficient accuracy. Again he disregards the all-important factor in forestry—"time"; for instance, given a certain area of forest the lower the rotation the larger the area annually attaining maturity.

The difficulty of persuading present and future Governments of the financial aspects of forestry should not be so great as Mr. Jerram anticipates. And certainly the peculiar views of laymen *cannot justify forest experts failing to try and persuade Government* of the soundness of economic forestry.

The case to be put to Government is not quite as Mr. Jerram represents it, namely, enhanced revenue now and lower revenue hereafter. It is rather, under present methods, the current revenue for as many years as it is decided to spread the mature stock over, and then probably a great falling off owing to the unavoidable neglect of sylviculture. Or, the alternative, supposing

rotations generally have to be reduced, of enhanced revenue now owing to reduction of stock and thereafter more than the revenue under the present system of working.

Since some years it has been the policy both in France and Germany to reduce, if not remove, the surplus growing stock ; and in a number of cases such revenue is now being placed to a reserve fund to meet extraordinary forest expenditure and equalise forest revenue. If the formation of such funds were not possible in India we still need not stop trying to convince Government of the wisdom of working the forests more economically.

For example, there should be little difficulty in persuading Government of the advantage of working the more valuable forests to give the greatest sustained profit, provided, say, the present fixed maximum annual outturn were not exceeded, and allowing surplus stock to remain in the less accessible or valuable areas.

Mr. Jerram's argument that nature having provided the capital is best able to determine the most suitable rate of interest betrays some want of confidence in scientific forestry. I am in agreement with him when he expresses this in reference to much that has been achieved in India in the past, but he overlooks what has been the real cause of these results, namely, regulated consumption instead of scientific sylviculture.

Mr. Jerram also argues that forestry tends to produce a larger number of trees on an area and so slower growth of individual trees. This argument presupposes that little, or no, advance can, or will, be made in the matter of thinning crops to such an extent as to grow the largest quantity of the most valuable produce in the shortest time. Again I am in agreement with Mr. Jerram if the present system of regulated consumption is to continue to be practised over the largest area possible with the staff available. But does not Mr. Jerram look forward to a time when with a larger trained staff more intense working may be possible ? And cannot a claim to an increase of the trained staff best be made by demonstration of what scientific forestry on an economic basis can achieve ?

A. D. BLASCHECK,
I. F. S.

NOTE ON THE COPPICING POWERS OF BABUL.

When I took charge of this Circle, I was very sceptical as to whether the babul produced coppice shoots worthy of the name, but I soon had to lay aside my scepticism after seeing one of the Guntur reserves which has been regularly treated as coppice for a term of years.

I have now made enquiries and find that in the Circle there are four districts which are specially interested in this question, Guntur, Bellary, Anantapur and Chingleput. I will put aside Guntur for the present as Mr. Scot is, I understand, preparing an exhaustive note on the subject which will be published in the *Indian Forester.*

Chingleput.

In this district the observations were made by Mr. S. Kuppuswami Chetty, who is of opinion that big trees do not, as a rule, produce coppice but trees under middle age do. He is also of opinion that when the stools get submerged for some period, as in tank beds, the coppice shoots die, but in cases where the coppice shoots are able to keep their heads above water they survive. He also states that in stiff clays where the soil becomes much cracked in the hot weather that the young shoots die and, I may add, that seedlings frequently die off for the same reason.

In this district the Pulrambakkam Block has been worked since 1902-03 and the following is a resume of the information furnished.

Coupes XXII and XXIII, ten years old.

Soil, sandy clay. Coppice growth fair. Big trees have not given any coppice, but 75 per cent of trees 3′—4′ in girth have developed shoots.

Five trees with stumps of 12″ diameter had 16 coppice shoots varying in height from 18′ to 20′ and in girth, at breast height, from

10″ to 22″. The average girth of 16 shoots was 15″. One stool of 14″ diameter produced two shoots of 18′ high and 19½″ and 12″ girth.

Coupe XXIV, nine years old.

Soil, water-logged. Only 10 per cent of the trees developed coppice. Four stumps varying from 9″—16″ diameter produced 13 shoots of 18′ to 20′ high with an average girth of 14″, the smallest shoot having a girth of 7″ and the largest 24″.

Two stools of 18″ diameter produced six shoots 18′ to 20′ high with an average girth of 19″.

I have taken the two latter separately, because they are unusually big stools to have reproduced, but it will be seen below that these are not isolated cases.

Coupe XXV, eight years old.

Conditions similar to preceding coupe.

Five stools of 7″ to 15″ diameter produced 16 shoots 9′ to 18′ high with an average girth of 12″.

One stool of 18″ diameter produced five shoots of 16′ high with an average girth of 14″.

Coupe XXVI, seven years old.

Conditions similar to coupes XXIV and XXV.

Five stools of 7″—12″ diameter produced 14 shoots of 8′ to 12′ high and with an average girth of 8″.

One stool of 19″ diameter produced two shoots of 12′ high and 10″ and 12″ in girth.

Coupe XXVIII, three to four years old.

Seventy-five per cent, all small trees, produced coppice and 25 per cent failed. Six stools of 12″ to 15″ diameter produced 27 shoots 6′ to 10′ high with an average girth of 4½″.

In the two younger coupes coppice reproduction is successful.

Anantapur.

In this district the observations were carried out by Mr. C. Hodgson in the Pamidi reserve. The soil is described by him as a very deep slimy clay of light colour with a little sand mixed

through it, not very porous but not quite impervious. The rain-fall is about 20 inches.

In compartments 5 and 6 saws were used and the month chosen for the felling (December) was also bad in Mr. Hodgson's opinion. No actual countings were made, but 90 per cent of the stools have failed. In the other compartments the axe was used and the trees cut as low as possible. Mr. Hodgson is evidently of opinion that the trimming of stumps has no effect on the reproduction by coppice, and he states that the great bulk of the shoots spring from close to the ground or just below and not from the cambium.

Unfortunately from this district we have observations on only young coppice, and the following gives a resumé of the observations :—

Compartment 7, sixteen months old.

No. of stools counted.	Dead.	Coppice.			
		Very good.	Good	Poor.	Very poor.
142	74	26	23	1	8

Mr. Hodgson thinks that only a portion of the very good coppice will survive and the rest fail. The following shows the size of the stools which have produced very good coppice :—

Below 8" diameter, $\frac{14}{43}$ or $\frac{1}{3}$.
About 8" do. $\frac{10}{17}$ or over $\frac{1}{2}$.
" 1' do. $\frac{2}{8}$ or $\frac{1}{4}$.
The height of the coppice varies from $1\frac{1}{4}'$ to $7'$.

Compartment 8, seven months old.

No. of stools counted.	Dead.	Coppice.			
		Very good.	Good.	Poor.	Very poor.
43	7	17	11	6	2

Proportion of stools that have produced very good coppice.

Stools below 8″ $\frac{6}{11}$ or over $\frac{1}{2}$.

Do. about 8″ $\frac{7}{16}$ or less than $\frac{1}{2}$.

Do. „ 1′ $\frac{4}{16}$ or $\frac{1}{4}$.

The height of the coppice varies from $1\frac{1}{4}'$ to 5′.

Bellary.

Observations in this district were carefully made by Mr. E. M. Crothers in the Molagavalli Reserve. He believes generally that the best results produced are from stools cut flush with the ground. In dry, well drained situations stools cut higher than 3″ do not usually produce shoots, but those in depressions produce shoots when cut up to 6″ above ground.

One stool of 34″ girth cut flush has coppiced, but, as a rule, in this reserve stools up to 24″ girth produce the best coppice. Two sample plots of half acre each were taken, No. 1 in high ground and No. 2 in a depression, and the following shows the result:—

Age of coppice 6 years.

STOOLS.			COPPICE SHOOTS.		
No.	Counted.	Failures.	Average per stool.	Average height.	Average girth at base.
1	14	7	2·28	4′ 10″	$5\frac{1}{2}$″
2	17	5	2·46	7′ 11″	8″

It is of course dangerous to generalise from the small number of observations made, and we may well await the report from Guntur before doing so; but we may take it, I think, that we can rely on obtaining effective coppice in this Circle, when the trees felled are not of great size.

The working-plans are, as a rule, based on our obtaining coppice from trees which are not above 9″ diameter and, as far as our experience goes at present, this appears to be confirmed by the present observations made.

MADRAS:
Dated 7th May 1912.

P. M. LUSHINGTON,
Conservator of Forests, C. C.

COPPICING OF BABUL IN GUNTUR DISTRICT, MADRAS PRESIDENCY.

Some months ago an article appeared in the *Indian Forester* on the coppicing powers of babul, and reference was made to the areas in this district which are treated under a working-plan prescribing regeneration by coppice. I remember, on first seeing the working plan for this area, before I had been in Guntur, being surprised that the regeneration of babul by coppice should be contemplated under any working-plan; for I had always looked on the species as one which coppiced very indifferently, if at all. There can, however, be no doubt that under certain conditions babul coppices well. The result of observations in areas felled in the Guntur Babul Working Circle during the last eighteen years is given in the accompanying statement. The Working Circle comprises six separate reserves, aggregating 4,817 acres and situated within a radius of 15 miles of Guntur (longitude 80° 30′; latitude 16° 17½′). The climate is very hot, rising as high as 115° or over towards the end of May. The rains commence early in June and with occasional breaks extend up to the end of October, the average rainfall being 32·35 inches. Except for slight depressions, the areas included in the Working Circle are all level. The surface soil is black cotton with a subsoil of kankar overlying gneissic rock. All these areas have at one time been under cultivation and the babul growth is the result of natural reproduction. In 1893 a working-plan for these areas, prescribing their treatment as coppice leaving 5—6 standards per acre, was prepared by Mr. A. W. Lushington, and this was in force till 1906-07. Under this plan the area was divided into 20 coupes corresponding to the number of years in the rotation. In 1906, it was decided to change the system of working; the rotation was considered too long, and it was thought desirable to cover the whole ground in a shorter period.

The coupes were therefore grouped into six larger coupes, one of which was to be worked over in each year, felling only trees 6 inches diameter or over at base and removing approximately half the growing stock in volume. The plan covers the period 1908-09

to 1913-14, but the system of felling prescribed was given effect to in 1907-08.

It is noticeable that the rate of development in height and girth of the coppice shoots, especially in the case of coupes felled prior to 1907-08 varies between wide limits. For instance, coppice 18 years old in Coupe I of Nidamarru Reserve varies from 14 to 26 feet in height and from 10 to 23 inches in girth, and to a greater or less degree the same applies to the growth in other coupes. The reason is that the stools from which the coppice shoots have originated were at the time of felling of uneven age. Small stools seem generally to put out a larger number of coppice shoots than those of more mature trees, but on the latter, with better developed root system, the growth of the coppice is more rapid.

From a valuation survey in each coupe the average rate of growth of the coppice could be arrived at, but this would not be of much value, for it would represent the results of the felling of an uneven aged wood and would apply only to an uneven aged wood in which the age classes were represented in the same proportion. The higher figures for height and girth given in columns 3 and 4 of the statement represent the best results in each coupe and the lower figures represent backward development. The average is somewhere between, depending principally on the proportion of stools cut in the coupe when at the best age to reproduce by coppice. No observations have yet been undertaken to determine the size of stool from which the best rate of coppice development may be expected, but so far as one can judge by general inspection, stools 6″—8″ in diameter at base result in the highest rate of increment in coppice reproduction and stools of this size may generally be relied on to reproduce by coppice. Stools of smaller diameter produce, as a rule, a larger number of coppice shoots, but their development in height and girth is less rapid. The present working-plan prescribes that stems over 8 inches diameter at the base may be felled 6 inches to 9 inches above the ground level "as it is found that babul coppices, more certainly if felled a little above the ground level." I am doubtful if this is the case. I think it best to cut all stools so that about a third

of the cut circumference is flush with the ground and the cut surface slopes upwards to 3 inches to 4 inches above the ground on the opposite side. In any case, the coppice reproduction of stools over 8 inches in diameter is much more uncertain than in the case of smaller ones. I think the figures given in the table show beyond doubt that under certain conditions the reproduction of babul by coppice is by no means to be despised. I understand that the same has been found to be the case in other districts, and I have found it so in other parts of Guntur where the conditions as to climate and elevation, etc., differed considerably from those prevailing in the Guntur Babul Working Circle. I measured coppice shoots 8 inches and 9½ inches in circumference at breast height from babul stools on a tank bed in Palnad Taluk (longitude, 79° 30′; latitude 16° 33′) which had been felled less than four years previously. There were three or more large coppice shoots from almost every stool and the volume of fuel obtained by coppice four years after felling cannot have been much less than the quantity that had been actually felled.

Why babul coppices in some cases and not in others can be at present only a matter of opinion. My impression is that the conditions under which it may be expected to coppice well are these :—The soil on which it grows must be admirably suited to the species and the situation must be such that the ground is flooded or at least water-logged during part of each year, but the floods must not last too long or they will kill both the coppice shoots and the parent stool. These conditions apply to all the areas on which I have seen babul coppicing, and I think that it might be found that babul would reproduce by coppice over much of the foreshore of the tanks on which it is commonly found. This is of course pure speculation and recorded statistics of the period during which floods have lasted would be necessary to prove whether or not the hypothesis in regard to the period of flooding, effecting coppice reproduction, was correct. It would be interesting to fell a sample strip on a tank bed where babul flourishes, so that as the level of the water rose and fell, the strip throughout its length would be flooded for different periods and to

record accurate observations of the dates during which different portions of the strip were flooded. Of the areas under the Guntur Babul Working Circle, Nidamarru, Kuragallu and Kolakalur are best stocked and give the best results in coppice reproduction. All these areas are actually under water for some period each year. In a normal year, the soil probably becomes water-logged towards the end of June, is actually under water before the end of July and from then to the end of October is at times completely submerged and at other merely saturated with water. Lam, Gollamudi and Narakodur reserves are never completely flooded, but the soil is saturated with moisture from early in June till the end of October. In June 1910 there were exceptionally heavy rains and the coupes in Kolakalur and Nidamarru reserves were under water continuously for nearly 2½ months. The result was that, owing to the number of stumps that died after these floods, the successful reproduction was reduced from 75·3 to 32·6 per cent. in Nidamarru Coupe II felled in 1908-09 and from 63·7 to 33·7 in Nidamarru Coupe I felled in 1909-10. The reproduction does not seem to have suffered so severely in the coupes felled in these years in Kolakalur reserve, probably the floods there were less severe. The percentage of reproduction in Kolakalur Coupe XIII was only 17·8 per cent, but in this coupe it was only 17·9 per cent from the stools of stumps felled in 1906-07. The soil in this coupe is not so well suited to babul, as there is a considerable mixture of red earth with the black cotton soil. I think in both cases this is the reason for the low percentage of reproduction in this coupe. Figures showing the percentage of reproduction have only been collected of coupes felled in 1904-05 and subsequent years. They have been arrived at by the enumeration of barren stumps and of stools which made coppice, on sample areas of 2 to 3 acres selected in each coupe.

J. S. SCOT,
I. F. S.

INSECT INVASIONS AND METHODS OF CONTROL IN AMERICAN CONIFEROUS FORESTS.

It has been definitely proved in the United States that certain species of insects are the primary agents that bring about the death of vast numbers of trees in the extensive coniferous forests of that country. At times, owing to causes that are at present little understood, the balance of nature becomes upset to such a degree, that insect depredations may assume the character of a definite invasion. This not infrequently results in the death of a large proportion of valuable timber over thousands of square miles. It has been estimated that for a ten-year period the average amount of timber in the forests throughout the United States, killed and appreciably reduced in value by the work of insects, represents an average annual loss of nearly £12,500,000. This is upwards of £2,500,000 annually in excess of the average yearly loss of timber caused by fires calculated since 1870.

Forest insect investigations are under the charge of Dr. A. D. Hopkins, who is an officer of the Bureau of Entomology of the United States Department of Agriculture. The many reports that have issued from his pen during the last decade are models of thorough investigation. He has conclusively demonstrated that Scolytid bark-beetles of the genus *Dendroctonus* are the worst foes the pine forests have to contend with. They do not confine their attacks to weakly trees, but many species prefer to attack matured and healthy examples. The basis of Dr. Hopkins' monograph of the genus has been a thorough study of the structure and life-history of these insects, and a careful discrimination between the slight characters exhibited by the many closely allied species. Their life-histories, on the other hand, were found to frequently exhibit very marked differences. The future success of economic work in forest entomology depends very largely upon the correct description, interpretation, and recognition of the generic and specific characters. This work in itself involves a large amount of purely scientific research into anatomical and technical details, which may appear in the eyes of those whose work is of a purely administrative character to be

devoid of practical value. Nevertheless, practical discoveries have almost always been based at the beginning on purely scientific research.

As examples of insect invasions on the American continent the following instances are notable. In the years 1890—92 the southern pine beetle (*Dendroctonus frontalis*. Zimm.) attacked and diffused itself over an area of forest amounting to 75,000 square miles. This area extended from West Virginia, through Maryland and Virginia into Columbia, northwards into Southern Pennsylvania and southwards into North Carolina. A very large proportion of the mature and young trees belonging to several species of spruce and pine were killed by this insect. The mountain pine beetle (*Dendroctonus monticola*, Hopk.), in one locality in north-eastern Oregon, is calculated to have killed in three years, 90—95 per cent of the lodge pole pines extending over an area of 100,000 acres. In the years 1900 and 1901 the eastern spruce beetle (*Dendroctonus piceaperda*, Hopk.), caused extensive destruction in the forests of north-eastern Maine. This attack was successfully controlled by confining the regular logging operations within the affected areas. The logs were placed in lakes and streams and floated down to the saw mills. With little or no additional expenditure, it resulted in a saving to one firm, according to its own estimates, of a sum exceeding £20,000.

In 1906 an extensive estate in southern Colorado suffered from an outbreak of the Black Hills beetle (*Dendroctonus ponderosæ*, Hopk.) This was controlled through the efforts of the owner who had some 500 of the infested trees felled and barked. This venture proved so successful that not a single infested and dying tree could be detected when the area was inspected two years later. Considerable unnecessary expenditure, however, was involved owing to the burning of the bark. This latter measure was not required, owing to the fact that the insects transform into the adult beetles within the inner bark. In such instances all that is necessary is the removal of the outer bark. Notwithstanding this unnecessary precaution, the value of the utilizable timber was stated as being more than enough to pay all the working

expenses. In the spring of 1907 this same species was ascertained to have effected 65,000 broad feet of timber in a large private estate in north central Colorado, a ranger having been specially deputed by the Forestry Service to make the examination. The owner was informed by the Bureau of Entomology, but did not take action. In the autumn of 1907 it was found that the hordes of the insect that had been allowed to emerge from the old infected trees had affected 240,000 broad feet of timber. This resulted in the owner agreeing to adopt the recommendations of the Bureau of Entomology, and 4,000 odd trees were cut down, the logs converted into lumber and the slabs burned. This course of action resulted in the desired destruction of the broods of the beetle. It is stated that the owner realised a sufficient revenue from the timber thus treated to cover all working expenses as well as leaving a profit afterwards of over $1,200. The forests were again examined, and it was found that this organised campaign resulted in a complete control of the ravages of the insect.

In such campaigns experience has shown that, as a rule, it is quite an unnecessary measure to attempt the total extermination of these bark beetles. The *sine quâ non* is to so reduce and weaken their forces that they are no longer capable of making an effective attack on healthy trees, but have to depend upon weakened and felled trees for their sustenance. On account of their small size the beetles have to occur in very large numbers before they can inaugurate a successful attack on healthy flourishing trees. Dr. Hopkins estimates that it is usually only necessary for from 50—75 per cent of one or more species in an infected area to be destroyed in order to render them subservient to complete control.

In India the first requirement for the foundation of a system of Forest Entomology is a thorough knowledge of the habits, economy, and life-history of each particular pest. As the life-histories of many insects occupy a period of three and even four years, the acquisition of such knowledge is both a slow and laborious process involving continuous and prolonged investigation. Such information once obtained is of permanent endurance, and

forms the basis upon which to devise all remedial and preventive measures. Until this requisite knowledge is available attempts at insect control are best left alone and, as Dr. Hopkins remarks, there is perhaps no other feature in the science and practice of forestry in which advice and application based on insufficient knowledge is so dangerous.

A. D. IMMS, B.A., D.Sc.

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UNLIMITED POSSIBILITIES.

The following lines were penned on hearing that the Forest officials of the——————district had been actually ordered by the——————*to double the grazing possibility of a* certain forest.

Under such orders an entirely new vista is opened out, the scope of which is unlimited. Should a province, for example, desire a few lacs more forest revenue, the Local Administration

or the Board of Revenue has now a precedent for ordering that the possibilities as laid down in the working-plans be doubled (or why impose any limit!), and that the new figures be duly worked up to, and *hey, presto*! the trick is done.

Data collected often with considerable difficulty, after long days in the sun succeeded by long nights of fevered unrest, are apparently apt to be considered in a certain province of the Indian Empire as of little account, in view of the superior knowledge, instinctive and inborn, as they have not had the experience by which alone it can be acquired, of the men in the shade.

" In a district that lies 'neath the blue mountain skies
The forests are wide and sufficient,
And the D. F. O's aim, which is always the same,
Is to render protection efficient.

To keep watch and ward o'er the ryot and guard,
Put down periodical blazing,
To banish the cow—' the poor man's '—you know,
And develop a system of grazing.

He worked at his scheme, both awake and a-dream
And suitable blocks he decided,
And the limits of head were fixed by the feed
That Nature had really provided.

But the powers that rule have thought him a fool
A really quite ignorant creature,
And shown that the feed of the jungly mead
Is settled by art and not Nature.

They say ' it won't do ; you've allowed for too few,
' Possibility's easily doubled,
' It may go all wrong, but we're not here for long
' So some other man will be troubled.'

P'raps 20 years hence when bosses get sense
And forests more thoughtfully run,
Less mess will be made by the men in the shade
Of the work of the men in the sun."

SYNTHETIC JUTE FROM WOOD-PULP.

Many rumours of jute substitutes have, from time to time, been recorded in these columns, but not one of them has ever come to anything for the sufficient reason that jute refuses to thrive anywhere out of the hot, steamy climate of parts of India, and particularly of Bengal and Assam. At all events, no one has been able to grow a fibre that can, in the matter of utility combined with cheapness, compete with jute. But what about the possibility of a sort of synthetic jute, *à la* synthetic indigo, camphor, and so forth? Not many people have thought of that; but, according to some authentic information that has reached Calcutta, something of that sort has been evolved in Germany. From information that has reached us, the idea seems to have originated in Belgium, where, it seems, its full value was not realised. A sharp German Syndicate, having amongst its members two influential German princes and a leading financier, perceived the true scope of the opening and bought up the patent, taking care not to pay too much for it.

* * * * * *

Like all good patents should be, this one for the manufacture of a jute substitute is a delightfully simple one. The various uses of paper yarn, which is a product of wood-pulp, have been known

for some little time now, and most people have heard how this astonishing yarn may be converted, among many other things, into "velvet pile" carpets, and, in the form of cellulose, into clothes. The idea of the Belgian inventor was to add additional strength to paper yarn (which was already reasonably strong), and this he accomplished by simply adding a percentage of cotton waste to the wood-pulp. The result, we are informed on excellent authority, is a yarn equal in strength to that of jute, but capable of being woven into a texture so fine that bags made from it are exactly suited for the packing of cement; that is to say, they are dustproof.

* * * * * *

But a more important consideration is that bags so made are being sold at about twenty per cent below the price of corresponding jute goods; while, under existing conditions, there is said to be a profit of over one hundred per cent, which will be still further increased as the price of jute falls. A factory of some three hundred looms has been opened at Oppeln, Germany, to work the patent, and great things appear to be expected; but we venture to think that an extended trial will be necessary before really definite conclusions can be drawn.

* * * * * *

But a powerful factor that stands in the way of the extended manufacture of this alleged jute substitute is the growing scarcity of timber suitable for the manufacture of wood-pulp. Each year this shortage grows more apparent in all parts of the world, and prices of this pulp are steadily, if not rapidly, mounting towards the point of prohibition. It takes somewhere between thirty to a hundred years to grow a tree for use as paper-pulp; jute galore matures in a single year, and can afford to smile sweetly at the wood-pulp tree. Jute wins the growing race, hands down. Even taking the new substitute at its face value, the greater the demand it sets up for raw material, the more costly it must become, for there is only a limited quantity of wood-pulp to go round, barely enough to supply existing needs, and by no chance can the supply be increased in less than thirty years, but more likely sixty would be required. The German Syndicate must really find a substitute

for wood-pulp, or their patent is not destined to disturb the jute world to any great extent. It is one thing to evolve a clever patent and quite another thing to work it on a commercial scale. Many a Syndicate has discovered that fact before to-day.—[*Capital.*]

FOREST WASTE CAUSES FAMINE.

By President John T. Procter,

Baptist College, Shanghai.

China's life-sapping famine, in which millions are suffering, is largely traceable to the wasting of the forests. One of the most horrible tragedies of the world might have been prevented by the careful use of these resources.

"China's hills and mountains are deforested. This is particularly true in the hilly country drained by the Yangste river, whose valley comprises the stricken district. The river brings the soil down with it. That is the reason why we have the Yellow sea. For three hundred miles out from land the ocean is discolored by the silt brought down by the Yangste. The hills are washed bare of soil. There is some hunting in these hills, but the animals live among the brush. For want of better fuel the natives burn this brush.

"Last August the Yangste overflowed and flooded about 40,000 acres of densely populated territory. This flood placed a population of 3,000,000 in want. In fifty years there has not been such another flood. Some of the victims have been drowned out for two consecutive years, some three years, some four years. They not only have lost food, they have lost hope.

"Much of the land that was inundated is at sea-level. It is drained by the most intricate system of canals in the world. I know of one city of 30,000 which is surrounded by canals. There are no roads to it because a road could not go half a mile without touching a canal. There are not even footpaths. The people make their way to and from the city in boats. This is their only means of communication."—[*American Forestry.*]

POSSIBILITY OF GROWING CORK IN INDIA.

The contraction in the supply of cork has been apparent for some years, and has given rise to higher prices. Cork is not grown in India; but, in the opinion of experts in forest economics who have been consulted on the subject, there is no known reason why it should not be grown on the warm and dry slopes of the hills of the various ranges. As is fairly well known, cork is the developed outer bark of the cork tree, the *Quercus suber*. It is not until the tree is 25 years old that the bark is cut, and fresh cuttings take place every eight or ten years, the tree itself living for about 150 years. The usual method of cutting the bark is to make longitudinal and transverse incisions, which admit of the cork being removed in semi-cylindrical pieces by means of a curved knife. Great care is required in the cutting, so that the inner bark may not be injured. The detached pieces are soaked in water, pressed flat, dried, and superficially charred to remove any decayed parts and to conceal blemishes. They are then packed in bales for the market. The chief sources of supply are Portugal and Spain, and in both these countries steps are being taken to restrict the export trade and thus secure still higher prices.

As regards Portugal the *Times* pointed out some time ago, that in consequence of the action of the Government in promising to the cork operatives that, in future, all cork wood must be manufactured into corks before leaving the country, a large number of cork merchants, many of whom are English, are unable to fulfil their contracts for the delivery of cork wood in other forms than that of corks. The merchants in question made representations to the Government showing that this decision would practically compel them to close their factories. The Government, however, replied that they must abide by their action in consequence of the engagements given to the operatives.

As regards Spain, the *Journal* of the London Chamber of Commerce has stated that during last December a meeting of the principal representatives of the cork industry in Spain took place in Madrid, when, in view of the shortage in the raw material

resulting from poor crops and large exports, it was decided to urge the Government to raise the export duty on cork wood from five to fifty pesetas per 100 kilos (equal to about Rs. 15 per cwt.) in order to provide a remedy for the crisis through which this industry is passing. The report of the British Chamber of Commerce for Spain states that the Ampurdam Valley and the Provinces of Estremadura, Jæn, Sevilla, and Huelva have large plantations of cork trees, the produce of which is eagerly sought by Spanish and foreign manufacturers. During late years the relatively low level of duties has enabled the foreign buyer to compete advantageously, with the result that the national industry has been to some extent paralyzed for want of working material. The aim in view, therefore, is to raise the price of cork wood for foreign manufacturers, in which case the demand for Spanish cork from abroad would be considerably reduced and native manufacturers benefited. The measure would also have the effect of creating a number of new industries of cork objects which at present Spain is obliged to import from other countries. At the termination of the meeting, the representatives visited the Prime Minister and the Minister of Finance to put before them the decisions arrived at Both Ministers promised to study the matter carefully, and, if necessary, to promulgate a law for the due protection of national manufacture.

Cork is exported in five forms, *viz.*—(1) lumps or slabs; (2) small squares; (3) corks; (4) sawdust and shavings; and (5) finished articles. The Spanish cork trade, which was formerly confined to the manufacture of corks, has been developing considerably for some time, as a result of the greater diversity of uses to which waste cork is being applied. This waste consists firstly of cork sawdust, shavings and scraps. These were formerly of no particular use, and were employed mainly for packing fruit, especially grapes. These have now become raw materials and are applied in many ways, thereby originating a certain number of new industries. A good deal of the waste cork is exported to the United States where it is largely used as insulating material in the form of bricks, the particles being compressed under great

heat and adhere firmly to each other without the addition of any binding material.

The imports of cork into India in 1911-12 amounted to 1,784 cwts. valued at Rs. 1,50,209. Rubber is used in various ways as a substitute for cork, but it is not yet certain how far the future course of rubber prices will affect such use. It seems, however, possible that experiment might advantageously be made with a view to growing cork in this country.—[*The Indian Trade Journal.*]

SOME INDIAN VERMIN.

The vermin that infest the forests and mountains of India form a considerable factor in the causes contributing to the diminution of game in this country; and, in undertaking the preservation of game, measures should be inaugurated for the destruction of such vermin as is harmful to the animals and birds included in the list for preservation.

In considering this matter, it would be necessary to catalogue the various species of animals, birds and reptiles to be placed on the black list; to review their particular attributes; to enquire into the question as to whether their misdeeds in regard to the destruction of game are counter-balanced by any benefits they may confer in other directions; and finally to decide the means that should be undertaken for their destruction.

Generally speaking, in adopting measures for the destruction of carnivorous animals, the authorities concerned have condemned only those beasts which are dangerous to human life, or which prey on domestic animals. Tigers, panthers, wolves, bears and hyænas are usually included in the list of animals for the killing of which rewards are paid, the two latter perhaps with scarcely sufficient reason, for the bear is a comparatively harmless animal, seldom threatening either human life or that of domestic creatures, whilst the hyæna is more of a scavenger than a beast of prey (although he is rather apt to display a partiality for donkeys) and the good he does in this respect most assuredly counter-balances the fact that he may occasionally be responsible for the death of a village

goat. We think this unsavoury creature might be left in peace to confer a benefit on the public by keeping down the pariah dogs, whilst the rewards now paid for the production of his somewhat mangy skin might be devoted to more deserving objects.

It is, however, unnecessary to consider any of the abovementioned animals in discussing this subject, as rewards are generally paid for their destruction throughout India, although it may be interesting to note the fact that in one Native State infested with tigers, rewards for the killing of these animals have been discontinued. This at any rate is a step in the right direction—from the sportsman's point of view.

But it seems to us that the question of predatory animals, even if they are destructive to game only, should also be considered, especially in view of the fact that certain species appear to be on the increase. First on the list we would place the wild dog, regarding whose extensive depredations we are receiving constant complaints. In localities where they were seldom met with in years gone by, large packs are now constantly seen, and, being such ruthless and persistent hunters, they doubtless destroy vast numbers of deer and such like harmless denizens of the forest. In some districts, indeed, they appear to have almost exterminated the game, so that it is not improbable that before long they will turn their attention to domestic animals, which they are said not to molest as a rule, although we have many recorded instances of their attacking and destroying cattle.

Having no natural enemies, he is able to increase and multiply without molestation. The habits of this creature are favourable to the adoption of measures for its extermination. Strychnine or other suitable poison might be used on the carcases of animals killed. By this means whole packs could be destroyed simultaneously, and it would appear to be a more certain method than any other for encompassing the destruction of this species of vermin which infests most of the jungles of India from Kashmir to Cape Comorin, killing wild sheep and antelope in Tibet, and slaying vast numbers of sambur and spotted deer throughout the Peninsula.

The misdeeds of other animals pale before those of the wicked red dog. Perhaps the next in order of demerit is the marten, found in the thick mountain forests of the Himalayas, Burma, and the Nilgiris. Although so numerous as to be very destructive to game, these animals are seldom met with unless sought for, owing to their arboreal habits. Colonel Ward, in his "Sportsman's Guide to Kashmir and Ladak," mentions having seen three of these creatures run down and kill a half-grown musk deer close to the place where he was encamped, and other observers have noticed them in pursuit of their prey, sometimes hunting in packs of five or six. Doubtless also they kill the young of many other animals—four-horned antelope, barking deer, and such-like, which inhabit the forests where they are found, and they take toll of the pheasants, chukor, and other feathered game.

Possibly we should have considered the various species of wild cats, some of which are most destructive and blood-thirsty, before the martens. Probably the most harmful of these, by reason of its abundance and extensive range, is the common jungle cat (*Felis chaus*), which commits depredations on the peafowl, hares, partridges, and also on occasion attacks the birds of the farm-yard. Jerdon mentions that one sprang out of a sugar-cane field, and seized and made off with a peafowl he had just shot. With the exception of trapping and shooting, stimulated by the grant of rewards, no methods of destruction suggest themselves for application to the wild cats. Other game-killing animals of this genus are the fishing-cat, the rusty spotted cat and the tiger-cat, whilst to these might be added the two species of lynx, the caracal and the Tibetan lynx, both of which, although blood-thirsty and harmful to game, probably do not exist in sufficient numbers to call for special attention. The caracal preys mostly on hares, gazelle, and peafowl, whilst the Tibet lynx is said to confine itself principally to blue hares, but the information regarding these animals is somewhat scanty owing to their scarcity and nocturnal habits.

The civet is a creature very destructive to birds and small mammals, so should not be spared when met with, and the palm-civet or toddy-cat has been accused of poaching, but is probably

comparatively harmless. The jackal, although somewhat mischievous at times, is chiefly a scavenger, whilst the various species of foxes appear to prey principally on insects, although they will doubtless not despise birds and small mammals, especially when met with in the snows of the Himalayas. If to this list we add the egg-stealing crows, the various birds of prey—such as eagles and hawks—our list of game-destroying vermin in India will be fairly complete. But it is especially and primarily to the wild dog, and in a secondary degree to the wild cats and martens, that we would direct the attention of those interested in the preservation of game.—[*Indian Field.*]

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SYLVICULTURAL RESEARCH FROM A FINANCIAL STANDPOINT.

The idea sometimes held by those unacquainted with the aims of sylvicultural research, that any expenditure on this branch should justify itself by an immediate increase of revenue as a direct result, is an entirely fallacious one, and is opposed to all experience connected with industrial development as applied to natural resources.

2. It can hardly be denied that scientific research is the basis on which the successful exploitation of most natural products has to rely. The financier relies on the scientific assayist to furnish him with correct details regarding the prospects of the gold mine in which he proposes to sink his money, and on him, not on the minor who digs the gold, lies the initial responsibility. The promoters of a rubber company do not go to the rubber broker for advice regarding the potentialities of the estate which they bring into successful bearing but to the planting expert.

3. As regards the value of scientific research to a planting industry it will suffice to quote one comparatively recent example,

that of the discovery, by the research staff at Periadeniya in Ceylon, of the phenomenon of "wound response" in Hevea rubber trees. This phenomenon which is characteristic of Hevea but not of all species of rubber, consists of the fact that the production of latex is greatly stimulated in the immediate neighbourhood of wounds, so that by continuing to tap successively on the edge of existing cuts a greatly enhanced yield is obtained, so much so that the recent enormous development of the rubber industry in the East, and the high yields obtained, are largely if not entirely the outcome of the discovery of this simple scientific phenomenon of wound response.

4. Sylvicultural research may be divided broadly into (1) experimental work and (2) statistical work. Economic forest working, based on correct financial principles, depends on a combination of both, and one of the chief aims of sylvicultural research is to obtain the highest possible money yield from the forest capital by (1) ascertaining the best cultural methods of working under given conditions, and (2) determining mathematically the capital (as represented by the growing stock) and the rotation which will produce the highest net money yield per acre. This applies both to natural forest crops and to plantations, existing and contemplated.

5. It may be argued that local forest officers are quite capable of managing the forests under their charge, and that special expenditure on sylvicultural research is therefore not warranted. It is certainly true that a capable forest officer can manage his charge to the best possible advantage just as the commander of a battleship can navigate his ship and work his guns. In the latter case, however, it is the metallurgist who is primarily responsible for the quality of the armour plating and of the gun-barrels, on which the efficiency of the ship depends, and it is the chemist who invents and manufactures the explosives which propel the projectiles. The commander has not ordinarily got the time or the opportunity to elaborate new inventions, though he may suggest them and give them practical trial when completed, and it is his business to take advantage of the increased efficiency promoted by such inventions.

So the local forest officer may suggest lines on which improvements in forest working may be elaborated, and may to some extent carry out experiments: the details of experimental and statistical work on a sufficient scale, however, require to be carried out by a special staff in order to ensure continuity and comprehensiveness, which is not ordinarily possible in the limited confines of a forest division, where changes of officers are frequent. No further proof of this is necessary than to instance the many requests for information and assistance on sylvicultural matters which are received by the Forest Research Institute from local forest officers, whose chief aim is to increase the efficiency of their methods of working in order to enhance the value of the forests under their charge and to increase their yield.

6. Assuming now that expenditure on sylvicultural research has to be justified by a more than corresponding ultimate increase in the net revenue of forests—a view which is not an unreasonable one to adopt—we may consider briefly how this can be accomplished.

7. In the *Indian Forester* for March 1912, Mr. A. D. Blascheck, in drawing attention to the remarkable absence in Indian forestry of any attempt to gauge the forest capital and to work the forests on a rotation which will produce the highest money return on that capital, makes the following apt statement :—" To obtain some idea of the magnitude of this capital, and how it varies with the rotation, it is only necessary to consider the case of an ideal forest in which all ages of trees are represented in such proportion as to provide for a sustained annual yield. In such a case if the rotation is 100 years the value of the immature crops ascertained by discounting their ultimate value with three per cent. is over 30 times the annual yield. And if in the same forests the rotation were 150 years and all ages of trees proportionally represented, the value of the growing stock would be three times as great. The capital employed would be trebled. In other words, the yield with a 150 year rotation must be about three times as great as with a 100 year rotation in order to produce the same financial results Obvious and simple as this may seem, the disregard of all such

considerations is one in respect of which the present forest policy in India is open to criticism. Gratifying as the increases in revenue and surplus may be, is it not time to enquire in many cases whether the results are commensurate with the capital employed?" These remarks naturally apply only to forests worked as money-making concerns of which there are vast areas in the Indian Empire.

8. In Saxony, where the progress of systematic forest management has been carefully recorded since 1817, the net returns from forests, after paying all possible items of expenditure, rose steadily from 4 shillings per acre per annum in that year to 21 shillings per acre per annum in 1903, an increase of 425 per cent. These figures represent the average for the whole *of the Saxon state forests, including good, bad and indifferent* forest. There are forests in this state growing on land not worth 5 shillings per acre for agricultural purposes which produce over 40 shillings per acre net revenue per annum. The forests are composed chiefly of a single species—spruce—whose sylvicultural requirements have been intimately studied and regarding which comprehensive statistics have been compiled, so that the relations between the forest capital and the maximum net revenue obtainable have been calculated to a nicety. This is merely one example : continental forest management, based on financial principles, can show many such, and the far-seeing Germans at any rate employ a special staff for statistical work, recognising its value in economic forestry.

9. In order to fix the "financial rotation," that is, the age at which forest should be felled in order to produce the highest possible return on the capital, a comparatively simple mathematical calculation in compound interest is involved. Why then, it may be asked, do we not proceed to apply this calculation to our forests and work them at the greatest profit? The answer is simple—first our knowledge of the requirements of even our principal forest trees is incomplete, and second, the statistical information at our command is inadequate and in many cases unreliable. The obvious remedy is to perfect our knowledge of the requirements of

our trees and to collect reliable statistics regarding their growth, in other words, to spend more money on sylvicultural research, with a view to recouping it manyfold later.

10. Another direction in which much improvement is desirable, from a financial point of view, is that of cultural work generally, and in particular the formation and tending of plantations. No financier would sink capital in the formation of a rubber plantation unless he had first obtained reliable expert advice as to the prospects of the concern, and had worked out the capital cost, recurring expenditure and probable receipts. And yet the amount of money lost by Government in unsuccessful ventures in plantation work has been considerable, the main reason being lack of data on which to base estimates. Money spent on experiments on a small scale is well justified on the ground that a reasonable proportion of experiments, if intelligently conducted, may be calculated to afford results of economic value. There is little excuse, however, for repeating mistakes and conducting unsuccessful experiments on a large scale in one locality after another: yet this has often been done, the main reason being that most of the information regarding experiments soon becomes lost or is not available, and even successful methods of cultivation, though known in one locality, may be unknown in others. It is one of the chief aims of the sylvicultural branch of the Research Institute to ascertain what has been done hitherto in plantation work in various localities, to experiment further where necessary, and to endeavour to ascertain the most profitable methods of cultivating forest crops under different conditions. It is of great importance that the work of collecting statistics in existing plantations should be pushed on, for without these it will be impossible to form estimates in the case of plantations contemplated in future, and without reliable estimates it will be impossible to put a check on the waste of money which has been a characteristic of some of the past efforts to establish plantations.

11. One of the chief aims of forest policy in India at present is the development of the forest resources of the country by the

construction of export works and the establishment of new markets for forest produce. In this connection one is apt to overlook the fact that unless improved sylvicultural systems of working the forests are introduced such development works will seldom pay the profits they should do, and may frequently result in failure. The great majority of Indian timber trees grow scattered over large areas of country, and even in the case of gregarious species the trees of marketable size are generally scattered widely among smaller trees of all ages. It requires no great effort to realise that if 150,000 marketable trees can be concentrated within 5 square miles instead of being scattered over 150 square miles, the cost of constructing export works for their exploitation will be greatly diminished, and the profits of the undertaking will be enormously enhanced. So much is this the case, that one of the greatest obstacles to financial success in the construction of export works in the forests of India at the present time is the fact that the marketable trees are too widely scattered to pay the cost of extraction. This condition of things can be improved only by the introduction of suitable sylvicultural systems, whereby concentration of working can be effected. These improvements cannot be introduced off hand without initial experiments, as the sylvicultural requirements of our timber trees are not sufficiently understood. Here again sylvicultural research must lie at the bottom of economic forest working.

12. Recent investigations have shown that there are good prospects of developing an industry in bamboo pulp for paper making, and a new and extensive source of forest revenue would thus be opened up. Should a heavy demand for bamboos over a certain tract thus arise, there would be considerable danger of over-working the more accessible areas : on the other hand if the bamboos are too lightly worked the area operated over would be unnecessarily large, and the cost of working would be greater than it should be. The correct method in which to work bamboos is at present a debatable question, which is receiving attention owing to its importance in certain parts of Northern India, where some of the bamboo areas have become impoverished through over-

working. It is desirable that experimental work in this direction should be pushed on in the case of those species of bamboo which are likely to form the main sources of pulp supply.

13. Another point in connection with bamboo working is the physiological fact that certain kinds of bamboos, including the two species which will form the bulk of the pulp supply in Burma, flower and seed gregariously over large areas at intervals of many years, and having seeded the clumps die, while the new bamboos resulting from the seed takes several years to reach exploitable size. In the event of a general flowering, a pulp factory depending on one species of bamboo would thus have its entire supply of raw material cut off for several years. Information is being collected from past records regarding the periods of seeding, and steps are being taken to record any future seed years of the chief bamboos. Information regarding the time taken for bamboos of different species again to attain exploitable dimensions after seeding, and the extent to which the gregarious flowering of the different species takes place, is very meagre. As the success or otherwise of the bamboo pulp industry depends largely on these physiological questions which can for the most part be cleared up by sylvicultural research, it follows that this branch of research has an important bearing on the financial success or otherwise of the bamboo pulp industry.

14. Many further examples could be quoted showing the importance of sylvicultural research in its direct bearing on the financial results of forest management in India, but those given will have to suffice. Were correct financial principles and rational methods of working, based on the results of sylvicultural experiments and statistics, applied to Indian forestry generally, it is impossible with the meagre data available to estimate what the annual gain to the revenues would ultimately be: given an adequate staff, the gain would probably not be reckoned in lacs but in crores.

15. From what has been stated regarding the aims of sylvicultural research, it will be seen that the narrow-minded view that one rupee spent on Monday should produce two rupees on

Tuesday is an unreasonable one. The time taken for sylvicultural research to show a money profit must of necessity depend on the subject dealt with. The ultimate gain to the State through the adoption of rational methods of sylviculture and forest finance has been amply proved in Europe. The adaptation of similar methods to the varying conditions of climate and vegetation in India, wherever they can be successfully introduced, is a matter of the greatest importance from a financial standpoint. With this object in view, expenditure on sylvicultural research is more than justified.

R. S. TROUP,
I. F. S.

FIRE-PROTECTION IN THE TROPICS.

In the May number of the *Indian Forester* Mr. Fischer has put forward what purports to be a comprehensive review of all that has been written on this subject, and I am embarrassed to find that I am responsible for sixteen out of the nineteen points selected by him as being the principal objections to fire-protection.

The points he has selected, however, are not the ones I should have chosen myself. For instance, point V is a foolish suggestion of mine that the destruction of dead leaves might be partly due to dessication. It is well known, however, that botanical specimens, etc., can be preserved *indefinitely*, merely by keeping them dry. Again point XII contains a suggestion that when leaves are eaten by insects, these insects may be preyed upon by other insects, and these by insectivorous birds, and these by birds of prey, etc., so that a long time may elapse before any nutritive material is restored to the soil. This is of course very puerile, but these and several other suggestions and surmises quoted have little significance, and can have little bearing on the main question.

I have therefore made my own selection of what I consider the most essential points, and shall endeavour to show that they are supported by adequate evidence. Although I have no experience outside Burma, I shall endeavour to discuss the question

in as general a manner as possible, but as according to my views the conclusions to be drawn on some points must vary according to local conditions, I can in such cases only attempt to show what the result is in Burma.

I.—Fires are of great antiquity and therefore a determining factor in the present distribution of species.

The evidence on which I base this belief is—

(*a*) that taungya cultivation, one of the principal causes of fire, is one of the earliest forms of cultivation, as is proved by the fact that this method of cultivation is still practised by primitive tribes throughout India and, I believe, Africa. Some years ago it was attempted in Burma to protect one huge block of forest, comprising part of three divisions, but a fire which crossed the fire line in one place, burnt over practically the whole area in spite of every effort to check it. It seems reasonable to suppose, therefore, that very few taungya fires would suffice to cause the greater part of the deciduous forest to be burnt over. The origin of fires may therefore, I think, be traced back to dim prehistoric periods when the use of fire and cultivation was first discovered ;

(*b*) that innumerable species can exist in these forests, and possess considerable powers of resistance to fire. It can perhaps best be realised how extraordinary this is, by comparing the powers of resistance to fire of the species found in Europe where fire is of rare occurrence. I do not believe, however, that evolution has played much part in adapting species to resist fire, for instance it seems to me highly improbable that the power of coppicing, or the habits of grasses and bamboos, have been developed by natural selection for this purpose. When fire first originated, much destruction must have been caused, but this would give an opportunity to the survivors to increase

and take their place, and it is probable that in the course of time some immigration has taken place. It seems to me, however, that there is reason to believe that evolution has played some part, although perhaps slight, in improving the powers of indigenous species to resist fire.

Although I should expect that the conclusion in question is applicable to India, I need hardly point out that it does not apply to all tropical countries. Judging by the slight powers of resistance, I am, for instance, inclined to agree with Mr. Fischer that "in North America forest fires were formerly neither as frequent nor as widespread as in the present time."

II.—Fire-protection disturbs the balance or equilibrium of the natural growing stock.

In his review Mr. Fischer appears to indicate that fire-protection must be either beneficial throughout the tropics, or the reverse, but as I view it, protection may be essential in one locality, of little importance in a second, and disastrous in a third. Our ignorance of the relation of one species to another is, however, so great, that I do not think it possible to predict with much confidence whether a particular species will gain or suffer, and therefore, I maintain, it is a matter which must be determined by careful experiment and observation. A few notes I have made on the subject may be of some interest, but I cannot vouch for their accuracy. Usually I have found that light demanders suffer, apparently because the degree of moisture is slightly increased and the growth becomes more dense so that moist loving shade bearing species are favoured.

In pure tree forests, and possibly in most types of forest, fire-protection appears to result in a greater volume of material, occasionally thickets of new poles being found which evidently originated at the time that the area was first protected, proving that formerly the area was not as fully stocked as it might be. Owing to the longer duration of their life, trees appear to be handicapped as compared with species of grass and bamboos,

and it is possible that some species of trees, although capable of continuing the race by moderate powers of resistance to fire so long as they are young and vigorous, yet succumb prematurely before they have attained large dimensions. Although it may seem strange, it is quite conceivable that, even in the case of one particular species, fire-protection may be beneficial in one locality and injurious in another. A species becomes scarce on the one side because the rainfall is insufficient and on the other because the rainfall is excessive, and it is possible that fire-protection, by *slightly increasing* the moisture, may assist the species in its competition with other species towards the dry extreme of its range, but be injurious on the other extreme. The species with which a particular species is associated may also affect the question. For instance, opinions have been expressed that fire-protection is unnecessary in Burma where teak is associated with bamboo, but necessary in India where it is found with an undergrowth of grass.

As we are trained in the artificial forests of Europe where the forests consist more or less of a series of what out here we should call plantations, I think I am justified in again putting forward a quotation from Darwin.* "Nothing is easier than to admit in words *the truth of the universal* struggle for life, or more difficult—at least I have found it so—than constantly to bear this conclusion in mind. Yet unless it be thoroughly engrained in the mind, the whole economy of nature, with every fact on distribution, rarity, abundance, extinction, and variation, will be dimly seen or quite misunderstood."

III.—In Burma teak has suffered under fire-protection.

This is one of the most important points on which the whole question is based. It is not sufficient to determine merely that teak has suffered, but it is essential to ascertain to what extent. *This information is, I think, supplied by* Mr. Troup's statistics. They were collected in a typical teak bearing area and it is generally admitted that they give a reliable estimate of the injury throughout moist teak forest generally.

* Origin of Species.

Mr. Fischer comments on the "bewildering situation" created by the extraordinary diversity of opinions, and a similar perplexity is apparent in the recent practice of referring to fire-protection as a "vexed" question. All that this amounts to is that opinions based on ocular estimates are of little value, and do not give us any right to suppose that an attempt made to solve this question on orthodox lines would present any difficulty. In the same way, if for working-plans purposes we attempted to regulate the yield by means of ocular estimates, we should inevitably get most fluctuating results, and create a similarly bewildering and vexed situation.

I must also refer to a quotation put forward by Mr. Fischer as a serious objection. "If fire is to be considered as an agent favouring teak at the expense of all (or almost all) other species, and if the teak forests have been burnt over for hundreds of thousands of years, it is pertinent to enquire why we do not find large areas of pure (or almost pure) teak forests."

The relation of one species to another is so complex that it is impossible to explain why one species is abundant and another scarce. This I should have thought would have been fairly obvious, and in any case little would be gained were it possible to answer such an enquiry; but if such an utter lack of comprehension of the economy of nature is displayed on this point, is it not probable that in Burma we are placing in jeopardy the natural growing stock of teak, which after all is our main source of revenue and not to be despised, without clearly understanding the risks involved?

I am entirely in favour of utilising the forces of nature where possible, and it is obvious that in many cases fire-protection may disturb the normal balance to the gain of the species it is desired to benefit, but when it is found that this is not the case, it seems folly to persevere. We know that the natural tendency of every species to increase is kept in check by the competition of other species, and when this check cannot be mitigated by indirect means, the only alternative seems to be to try direct means, and to cut back inferior species wherever they are doing harm to our valuable species.

IV.—As the extent of the damage caused by fire is one of the most important considerations it is essential to make reliable valuations and to compare this with the cost of protection. In Burma, for instance, the value of the damage is comparatively small.

In reviewing this important point Mr. Fischer may have intended to be impartial, but his objection that "as Mr. Rodger has shown that this depreciation extends to 60 per cent of the crop one is justified in enquiring whether Mr. Walker is prepared to rest content with a 40 per cent standard of soundness" reeks of prejudice.

Mr. Rodger explained that only 8 per cent of the trees examined by him were rendered unsound, and it is an exaggeration to include a further 52 per cent as unsound when it was clearly stated that their commercial value was not affected. Further it is doubtful how much of this injury should be put down to ordinary leaf fires, as he attributed a great part of the injury to the serious conflagration of 1852 which must have taken place after the general flowering of the bamboo. He did, however, suggest that in the case of the 52 per cent the exposure of the dead wood would pave the way to further injury, but the trees examined by him were already mature and were selected for girdling, and it is immaterial therefore whether, had they been left standing, the injury would have extended. He was perhaps thinking of immature trees for which however he collected no statistics. The appearance of the scar however generally indicates that the injury is not recent, and has not been kept open or increased by subsequent fires. This however could have been inferred from Mr. Rodger's statistics, as if every immature tree which had been scarred by fire were to be further injured by each successive fire, the percentage of trees of which the commercial value was appreciably affected at maturity, would be very much greater than 8 per cent.

As regards the general principle involved Mr. Fischer expresses an opinion that it is "somewhat superfluous to produce evidence in support of fire-protection." It is true that he quotes many opinions, although mostly those of a former generation

which had not our opportunities of observing the effect of continued protection. Under our organisation opinions have an entirely fictitious value which varies according to the official position of the owner, and not according to the reasons on which they are based ; but opinions when based on ocular estimates are not necessarily sound evidence, and I cannot admit therefore that Mr. Fischer's industry has given us a final solution of the question.

It is not only not superfluous to produce evidence in support of fire-protection, but extremely desirable to do so, not only that we may be in a position to rebut the charge that we are wasting public money entrusted to us, but that we may make a fairly approximate estimate of the progress we are making. It seems however rather elementary having to point out that forestry is largely a question of rupees, annas, and pies, but in India this is very usually ignored.

It is true that in Volume III of Schlich's Manuals of Forestry no suitable formula has been given, but the calculations present no serious difficulties, and with Mr. Rodger's statistics it is possible to make a fairly reliable estimate of the damage caused by fire and to compare it with the cost of protection. Different results may be expected owing to different methods of calculation and different allowances for average volume of tree, value, rate of interest, etc., but both the late Mr. Slade and myself have published calculations showing that the value of the damage is so small that even by increasing these allowances to the utmost, it is impossible to bring it within measurable distance of the cost of protection.

There is an element of humour in comparing our troubles here and in the United States of America. In the latter our colleagues, although the service is of recent origin, have gone to work in the orthodox manner, but although their statistics of the damage and cost of conservancy operations prove that the scheme of protective works proposed would be a wise and remunerative measure of insurance, their allotment has been severely cut down ; whereas in Burma where nearly everyone acquainted with local conditions is convinced that protection is not required, money for this purpose is showered upon us. If perhaps we think that, in

neither case have the powers that be, displayed the wisdom of a serpent, yet we at least may console ourselves with the reflection that it is much pleasanter to suffer under a light hearted and reckless extravagance than a tight fisted meanness. The comparison is the more extraordinary as I understand that in the States the finances are flourishing, whereas in Burma they are at present in such a state that one would expect expenditure to be carefully scrutinized.

V.—The fact that hollow trees are sometimes found in unprotected areas cannot in the majority of cases be attributed to the action of fire.

The 8 per cent of mature trees rendered unsound by fire comprise only simple cases where the damage has extended from the outside, but in addition to this I understand it is claimed that the burning back of the seedling causes injury which frequently results in the tree ultimately becoming hollow, although intact on the outside. If however hollowness were due to this cause I maintain that it would be possible to trace the development of the decay at all stages of growth, but of the saplings I have examined, in no case have I been able to find that the injury has extended. So far as I can ascertain also the decay in the taproot due to repeated burning back is subsequently entirely enclosed in living tissue, and I believe, although I cannot remember on what authority, that decay cannot develop without access to air. Hollow trees certainly are found, but they are not restricted to areas burnt over. For some reason or other most tap-rooted species display a tendency to become hollow in later years. Many of our over-mature teak trees become hollow, but in England old oak trees tend to become hollow in the same way, and therefore it seems reasonable that the cause should be the same in both cases, namely, old age. Suppression frequently produces the symptoms of old age, and I have observed in plantations in protected areas, where of course the seedlings have never been burnt back, that some of the badly suppressed stems show traces of decay at the core. I do not know how the percentage of hollow trees in Burma

compares with that of Padauk in the Andamans, but although the latter are never subject to annual fires hollow trees are not unusual.

I have little doubt in my own mind that old age and suppression are frequently causes of internal decay, and am uncertain whether this is disputed or not, but the facts so far as I have been able to observe them do not support the view that there is any connection between the burning back of a seedling and internal decay in later years.

VI.—Other injuries may in some localities be of greater importance than that of fire. In Burma for instance the competition of inferior species is more detrimental to teak than fire.

Assuming that fire-protection does not indirectly benefit the species we desire to favour, the question depends mainly on whether the injury caused by fire is sufficient to justify the cost of protection. As however the work which can be attempted in a tropical forest is limited, it is necessary to consider, even if fire-protection does pay, whether the available funds could not be utilised to better purpose in other ways. Since however I have recently discussed this aspect of the question in great detail as regards Burma, I need not relabour the point.

VII.—Fire does not cause impoverishment of the soil.

We have had abundant opportunities of seeing areas of deciduous forests cleared for field crops, and it seems to be generally admitted that the soil is exceedingly fertile and contains abundant supplies of nutriment, sufficient to support field crops for some considerable time without recourse to manure or artificial fertilisers. It is not perhaps possible to compare our growth with that of the fireless forests of Europe, but the growth as a whole seems sufficiently good to justify the belief that the soil in our deciduous forests is not deficient in any essential food material. Nevertheless it has been asserted most emphatically and dogmatically, with a "there can be no doubt" or "it is not disputed," etc., that fire does impoverish the soil, but in scrutinising such expressions of opinion I have come to the conclusion that such opinions are

based, not on the actual state of growth, which is a matter on which every forest officer should be able to express a reliable opinion, but entirely on theoretical grounds to which I will refer later on.

In this connection Mr. Fischer quotes the following statement :—" After an area has been subject to fires for a great number of years the soil often gets into a very bad state, and it may take many years of protection to bring it into a suitable condition to form a seed bed for the principal species " and adds that these remarks seem "pregnant with significance." To me they seem uncommonly tough. Unless Sal is more exacting than a field crop, it would follow that when the forest is cleared for cultivation, no crop could be grown unless the area were heavily manured or allowed to lie fallow for many years, and I should doubt that such is the case. Although it is rash to criticise observations in a locality of which one has had no experience, yet on general principles I should feel inclined to attribute the tardy appearance of Sal, not to the badness of the soil, but to the habits of the species with which it is associated. In Burma in some taungya clearings, grass springs up densely and retards for a time the growth of bamboo and trees which are the original and natural species of the area. Similarly tree growth flourishes in the same area as bamboos, but in a flowered area no tree reproduction is possible for some considerable time until the bamboo nears maturity and opens out. It is rather extraordinary, but not contrary to my views, that the effect of fire-protection in disturbing the balance and altering the proportion of species in a locality should be retarded, and then be suddenly conspicuous, but I should find it difficult to believe that this result was due to impoverishment of the soil and I would suggest that this belief be tested by applying different fertilisers to ascertain exactly what food material is deficient.

These comprise in my opinion the only important points which have to be taken into consideration in determining whether fire-protection should be continued or not, and for which, therefore, accurate information according to the local conditions is absolutely essential.

The remaining matters I consider merely of academic interest especially in Burma where teak occurs more plentifully on ridges and on poorer soils. Not that teak will not thrive excellently on rich deep soils, and in a moist climate—in Arakan for instance the growth of teak in plantations is as rapid as anywhere in Burma, but as the rainfall is excessive it is not indigenous—but that it is crowded out by other species, and being a light demander can establish itself more plentifully where the competition is reduced by the physical poorness of the soil.

These matters have, however, been exploited as serious argument in favour of fire-protection, and therefore I think it is necessary to scrutinise the evidence.

VIII.—Earthworms in the tropics are not such an important factor in promoting the fertility of the soil as in temperate climates, and are comparatively scarce.

The subject is discussed in sufficient detail by Professor Drummond in his "Tropical Africa" which may be referred to. His conclusion is practically that given above, and therefore I do not consider it necessary to discuss the point.

Mr. Fischer claims on the authority of M. Jacquot that one of the results of fire is the migration of earthworms, but in the tropics it seems to me highly improbable that earthworms remain close to the surface during the hot weather. They remain, I believe, in the subsoils where there is still moisture, and are, therefore, not affected by superficial leaf fires.

IX.—Decomposition in the tropics is very rapid and the result is practically identical with that of combustion.

I have expressed an opinion that in a protected area the dead leaves disappear very rapidly during the rains. This has been disputed, but surely it is a matter which everyone can verify from his own personal experience. Although insects may help, this is, I think, mainly due to bacterial activity, which is greatly increased in warm tropical countries. In his translation of "Incendies en Forêt" Mr. Fischer uses the expression "decomposed by fire" and the following quotations show that there

is no practical difference between natural decomposition and combustion* :—" In decaying, plants return to the air and earth the materials of which they were constructed," and again† " decay and burning are simply different rates of progress of the same change." The effect of *slow* decomposition which results in the formation of humus and vegetable mould is very much more complex, and is well known to be beneficial to the soil, but, admitting that decomposition is exceedingly rapid in the tropics, it seems futile to insist that the beneficial effects of slow decomposition are realised.

X.—There is no deficiency of nitrogen in deciduous forests.

Mr. Fischer has very unkindly made me responsible for the opinion "either that nitrogen is not an essential plant food, or that it remains in the ash," and maintains that both conceptions are false. I quite agree, but I have never expressed any such opinion. On the contrary I have always been careful to admit that the question of nitrogen offers the principal difficulty, on the grounds that it is one of the most important plant foods, and the one most liable to be exhausted, and because, when leaves are burnt, the nitrogen is dissipated into the atmosphere, whereas the supply required is taken up by plants through the roots.

In Europe it has been established by M. Henry, M. Detrié and others that forest crops obtain their supplies through the power of slowly decomposing vegetation (humus or mould) to retain and increase the store of nitrogen in the dead leaves. But *gradual* decomposition appears to be essential.‡ Thus " nitrates cannot be formed in the rapid or putrefactive stages of decay, but only later when the process proceeds so slowly that oxygen is in large excess." This applies equally to his contention that the nitrogen in the dead bodies and *fæces* of leaf-eating creatures is wholly restored to the soil. A familiar instance is the pungent odour of stables due to the dissipation into the air of compounds containing nitrogen.

* Sir J. H. Hooker's Botany Primer.

† Cousin's Chemistry of the Garden.

‡ Johnson's " How Crops Feed."

He concluded that "it seems impossible to deny that annually recurring fires must diminish the quantity of nitrogen in the soil until, at the long last, the amount left is insufficient to support a forest crop." As however there is almost exactly the same loss when fires do not occur, the conclusion applies equally to a protected forest. The supply of nitrates, however, is not inexhaustible, and therefore it is mathematically demonstrable that, if the loss was not made good in some way, the supply would have been exhausted many years ago, and we should have no forest crops at all. Growth is however luxuriant enough and it follows therefore that however plausible Mr. Fischer's theories may be, they must be unsound.

It appears however to be definitely proved that* "the formation of nitrates goes on most rapidly in hot weather and in hot climates," and againt† "in Bengal, during the dry season, when for several months rain seldom or never falls, an incrustation of saline matters, chiefly nitrate of potash, accumulates on the surface of those soils which are most fertile, and which, although cultivated during the wet season only, yield two or three crops of grain, etc., yearly." If the supply of nitrates can therefore be maintained naturally in the tropics for exacting field crops there does not appear any danger of a deficiency for forest crops. The fixation of nitrogen in a form in which it can be taken up by plants appears to be due to micro-organisms and therefore it may be a dispensation of nature that, as the absence of true humus is due to one form of bacterial activity, the supply of nitrogen should be maintained by another.

The result of the Rothampstead experiments appeared to me to throw still further light on the question. The subject was discussed in "Nature" and so far as I remember, one experiment was described proving that the benefit derived from burning branches on a field (known I believe as *rab*) was due, not so much to the ash as to the heating of the soil, and so far as I could gather the opinion of experts inclined to the view that even hot sunlight

* Johnson's "How Crops Feed."

† Ibid.

exercised a beneficial effect. Mr. Fischer objects on the grounds that the nitrogenous fixing bacteria are themselves destroyed, but the experiment described appears conclusive.

Mr. Fischer concludes that as the result of combustion the nitrogen of the dead leaves is entirely lost. So far as I can ascertain the result of combustion, rapid decomposition of dead leaves and putrefaction of the dead bodies and *fæces* of leaf-eating insects is almost identical, namely, to dissipate the nitrogen into the atmosphere, not as pure nitrogen, but mainly in the form of ammonia compounds, and that much of the nitrogen may be restored to the soil by the first showers of the rains. So far as I can judge however this is an entirely negligible source of supply, and the main source in the tropics appears to be due to nitrofixing organisms which have the power of fixing nitrogen from the atmosphere.

XI.—The expansion and contraction of the soil consequent on alterations of dryness and moisture contribute towards fertility.

In his general conclusions Mr. Fischer states that forest fires are injurious as they result in dessication and lack of aeration, but he does not indicate how this conclusion is arrived at. An expert, to whom I was introduced last time I was on leave, informed me that it was highly probable that the contraction of the soil in the dry weather, which is enhanced by the heat of fire, contributed to fertility by the disintegration of the soil, and by the aeration due to air replacing the moisture evaporated. The effect seems comparable with that of frost or tillage.

XII.—The loss of minerals in leaf ash through the agency of wind and water does not result in a deficiency.

I have been credited with doubting whether there is any loss whatever, whereas I have merely wished to protest against exaggeration on this point.

Mineral salts required by plants are taken up by the roots and are therefore soluble in water, and it follows therefore that a considerable loss must result even in protected areas owing to the surplus water being drained off into streams. If Mr. Fischer

admits this, as I think he must, does he find himself driven to the conclusion that, as the loss is recurring, the amount left must, at the long last, be insufficient to support a forest crop?

Alluvial deposits brought down by a river, whether from areas habitually burnt over, or from areas where fire is unknown, are invariably extraordinarily rich and fertile, but does it follow that the areas from which the silt has been derived have been ruined? Much is made of the fact that every trace of ash is removed by the wind, but if a few ashes are well pulverised and scattered broadcast on a perfectly calm day it is equally difficult to find them, although it is certain that they have not been carried away. Rub a few ashes well into one's clothes, and it is found they are tenacious and not readily removed. Keep a handful for a few days and it is found that even in dry weather they become slightly moist, having attracted hygroscopic moisture, and are still less likely to be wafted long distances. Put a few ashes in water and it may be seen that they are distinctly heavy.

On no points are the opinions quoted by Mr. Fischer more *overwhelming and authoritative and he states that he could cite* many more. We have the clear evidence of our eyes that the smoke of a smoky town and the dust of the dusty road are not carried great distances, and yet we are to believe that the comparatively heavy ashes left by a fire are entirely wafted away by the wind, and washed away by the first rush of the rains. One wonders at the folly of Burmans continuing to cut *taungyas* on hillsides at all. In Arakan I can vouch for the fact that the slopes in the administered Hill Tracts are unpleasantly steep, yet although windstorms are frequent in the hot weather, and the rainfall somewhere in the region of 200 inches, the poor ignorant hill people imagine that they get excellent crops of paddy from their *taungyas*. Little do they know that it has been conclusively proved that not a particle of ash can remain.

XIII.—Floods do not materially decrease in areas protected from fire.

In my opinion there is an appreciable difference in the floods during the rains and in the amount of water found in the hot weather, but my experience is in Burma that for purposes of

calculation it is not necessary to make any deduction for the increased difficulty of floating logs out from a protected area, or any allowance for abundance of water in the smaller streams during the hot weather. Unless the differences represent some value in cash it seems to me that they are immaterial. Mr. Fischer however makes me responsible for a statement I have never made, and he sarcastically suggests that my experience must have been very limited.

I do not deny that my experience is limited. I have no idea of the extent of the damage caused by fire, nor of the manner in which protection has affected the relation of the species in Madras for instance, but I have restricted myself to the teak forest of Burma *with which I am well acquainted. It seems to me however* that this wideness of experience is not altogether an advantage when, for instance, it results in a conclusion that the beneficial effects of humus in a French forest must be equally present in a tropical forest, or that because Sal is affected in a particular way the effect on teak must be identical. In the Administration Report for 1900-01, Southern Circle, the following passage occurs:—"Several Forest Officers still give expression in official reports to the fallacy that fire-protection is inimicable to natural reproduction of teak in its earliest stages, an erroneous idea which less *superficial observation has generally dispelled." It is evident that* this opinion was sincerely and strongly held, but as has so frequently happened the author was transferred to Burma late in his service, and in view of the overwhelming evidence on this point, it is impossible to avoid the conclusion that his opinion was based, not on actual facts in Burma, but on his previous experience in India.

I think I am correct in saying that the only officers who have been consulted officially with regard to the question of fire-protection have, like the distinguished officer just referred to, come to Burma late in their service, yet on the other hand all Divisional Officers, who after all have had ample opportunities of studying local conditions, are, I believe, without exception, opposed to too much fire-protection.

As I have pointed out, the fact that the question of fire-protection is mainly one of rupees, annas and pies, has always been ignored, but in spite of official apathy, and seeing that a broad hint was given in a Government resolution that any open expression of opinion adverse to protection would be regarded unfavourable. I may add that in spite of official antagonism, reliable statistics have been collected by private enterprise on the more important points. Other minor matters have been freely discussed, and where there appears to be some doubt the earliest opportunity has been taken of verifying the facts by further observations, with the result that there is a great degree of unanimity on all matters having an important bearing on the question. There are many points on which it is desirable to make further observations and experiments, but taking everything into consideration, I am inclined to think that Divisional Officers in Burma could present as reliable and as clear a statement of the profits or loss of fire-protection as their colleagues in any other Province.

H. C. WALKER,
Dy. Conservator of Forests,
Arakan Division.

AKYAB :
June 1912.

FOREST FIRES.

In the May 1912 number of the *Indian Forester* Mr. Fischer publishes a most interesting resumé of all the available evidence which has appeared in connection with fire-protection. He most faithfully records the *pros* and *cons* of the position of affairs upon which he has, with the help of his personal experience, drawn certain conclusions.

Carefully as all the points have been considered the writer cannot agree with him when he states on page 221 that "*In all* forests fire is harmful." He adds in the next clause II, "In certain forests, however, fire protection unaided by other operations hinders the natural reproduction, etc." The above statements no doubt apply to many forests though by no means to all. An attempt will be made to prove this point by giving an example.

In the North Kanara Division of Bombay on the Western Ghats teak forest occurs on the upper slopes which extend over the top of the Ghats some distance inland. Between the upper slopes and extending some 60 miles westward towards the sea there exist moist deciduous and evergreen forests, situated on the spurs and in the valleys of the Western Ghats. The forests here are very fine, consisting of true evergreens on the upper shady slope which pass into semi-evergreens chiefly of *Xylia dolabriformis* and so on into moist deciduous forests, in which a limited amount of teak and many *Terminalias, Lagerstrœmias, Dalbergias, Dillenias*, etc., play an important part. Generally along the edges of the river and especially on the by-streams which run up into the Ghats, narrow belts of evergreen are to be found. Now these moist deciduous forests, with the exception of the evergreens, have been successfully protected from fire for more than 30 years. The writer prepared working-plans for some of them, and even without such a thorough inspection as is necessary in order to carry out that work, it is quite apparent that the evergreens are fast encroaching on the moist deciduous forest. Instance after instance can be seen of old well-grown *Terminalia tomentosa* and tall *Lagerstrœmia microcarpa*, both very valuable species in that locality, standing far above a dense crop of true and comparatively young evergreen, in which not a deciduous seedling is to be found. This gradual transformation the writer puts down to fire-protection, and to nothing else and for this reason, that though undoubtedly most of the deciduous species suffer more or less from fire especially in the seedling stage, the evergreen species suffer in proportion much more severely. The transition stage is not generally a direct one from the moist deciduous to true evergreen type, but what generally takes place is for the moist deciduous to give place to forests of which over 50 per cent is made up of *Xylia dolabriformis*, in which the evergreens gradually appear and eventually take possession of the soil.

It appears impossible to lay down any general rule in connection with fire-protection for the whole of India, and this is the conclusion arrived at by the writer after having visited forests in

several provinces of India and also in Burma. There are without doubt forests which require strict fire-protection, and there are at the same time forests which require no fire-protection and between these two limits there exist every shade and grade of forest. The difficulty is not in laying down a law either for or against fire-protection, but to draw the line where fire protection should begin and where it should end.

In support of the above argument it is proposed to give a few examples. In the Satpuras, or again in most of the Deccan forests or in the dry areas of Guzerat and Rajputana, where we have dry deciduous teak forests and a crop of still drier high grass, the results of fire-protection are everywhere evident, though it must be admitted that while in many places teak seedlings appear in fair numbers, other species such as *Albizzia*, *Acacia*, *Anogeissus* and *Dalbergia* seem to benefit still more from fire-protection. Another instance of the necessity of fire-protection is afforded by the forests on the north bank of the Brahmaputra in the Lakhimpur Division of Assam, where *Bombax malabaricum* and *Bombax insigne* grow in a way which is seldom found in any other part of India. The timber of these two species is in great demand for tea-boxes, but the supply is now running short, and for the reason that nothing has been done to protect the millions of seedlings which try to get through but which are cut back by the annual fires which take place in these grass lands. Even protection for a period of five years would do much to establish these *Bombax* forests. The above examples are given to illustrate the one extreme. As an example of the other limit, the example of the Kanara forests has been cited, to which may be added the case of most of the Cachar forests in Assam in which a similar process of transformation to that going on in Kanara is taking place, but on somewhat different lines owing to the different conditions of locality and to the diversity of species found in those forests.

Between these two extremes there exist every variety of forests, amongst which may be classed the moist teak forests of Burma. Mr. Fischer maintains that improvement fellings will g far to do that which other foresters claim is partially accomplished

by fires. It is not here intended to go into the question whether it is possible to carry out improvement fellings sufficiently often in order to establish teak regeneration in those forests. The writer is convinced that it cannot be done with the present available establishment. The debatable point is whether fire-protected areas contain a smaller number of seedlings than unprotected areas. The writer only inspected a very limited number of forests in four Divisions of Burma, but from what he saw, especially in the Toungoo and Pyinmana Divisions, he has not the slightest doubt that he saw many times the number of teak seedlings in unprotected forests.

The conclusions therefore arrived at by the writer are that it is extremely doubtful if any fixed rule can be laid down as regards *fire-protection in India and Burma*, and that to determine whether it is necessary in any given area or not, it is advisable for an officer to approach the subject with an open mind and then after having had at least two or three years' experience in that locality, to decide whether or not fire-protection is necessary.

R. S. PEARSON,
I. F. S.

A NOTE ON THE NATURAL REGENERATION OF PYINKADO IN THE MINHLA AND MOKKA RESERVES OF THE THARRAWADDY FOREST DIVISION.

The Conservator of Forests, Pegu Circle, having noted on my diary for week ending 20th January 1912 that a short account of the Pyinkado regeneration dealt with by me during the seasons 1910-11 and 1911-12 would be of interest I beg to submit the following report :—

1. The original idea was to make an ordinary Improvement Fellings in Compartments 11 and 12 of the Minhla Reserve, to free teak and Pyinkado poles and trees, but finding that the regeneration of Pyinkado was so very good. I decided to make a very heavy felling in order to give it every advantage.

2. Finding the above two Compartments so good, I was led to examine other areas in the vicinity and found that the

following Compartments contained Pyinkado regeneration on a similar scale, *i.e.* :—

Minhla Compartments 10, 11, 12, 15.

Mokka Compartments 30, 31, 32, 33, 34, 35, 41, 42, 51 and 52.

These forests are included in what might be called the Sub-Yoma portions of the *Minhla* and *Mokka* Reserves, which consist of undulating country easily accessible to carts, in which the extraction of Pyinkado is possible at a reasonable cost.

3. *Description of the forests.*—These Compartments, with the exception of Mokka 41 and 42 which are moist, may be described generally as dry forest throughout, bamboos being absent over considerable areas, elsewhere Thaikwa (*Bambusa Tulda*) and Myinwa (*Dendrocalamus strictus*) occur.

The following table of figures taken from the working-plans of these forests made for Minhla Reserve in 1887-88 and for Mokka Reserve in 1884-85 will give a very fair idea of the mixture of species in these areas :—

R serve.	Compartment.	Areas including plantations.	WORKING-PLANS ESTIMATE OF TREES 1 FOOT DIAMETER AND OVER.			
			Teak.	Pyinkado.	Pyinma.	All others.
Minhla ...	10	678	2,289	3,595	960	18,848
	11	430	1,239	1,121	1,046	9,363
	12	548	387	411	183	2,514
	15	559	447	517	112	2,425
Mokka ...	30	304	544	1,636	410	7,083
	31	388	1,239	990	770	12,526
	32	293	759	1,397	994	8,599
	33	235	1,282	1,462	382	9,457
	34	282	1,299	1,635	864	11,607
	35	208	609	728	298	4,521
	41	1,058	2,228	1,433	68	9,342
	42	772	1,118	1,101	203	9,554
	51	251	1,076	700	236	4,436
	52	346	664	759	301	6,153

4. While engaged on Improvement Fellings in Compartments 11 and 12 in 1910-11, the writer found that these Compartments contained a very considerable amount of regeneration of Pyinkado which was fairly well in evidence and badly wanted help by

removal of the overhead cover of inferior species. This regeneration might fitly be termed "Advance growth" in view of the fact that the subsequent felling was so heavy as to amount virtually to a regeneration felling of the Regular Method.

This felling consisted in the removal practically of all trees except Teak, Pyinkado and Pyinma. During season 1911-12 when work was started earlier, these Compartments were thoroughly cleaned and a secondary felling was made, damaged poles being cut back at the same time. All that now remains to be done, to complete what is practically a regeneration felling, is the removal of the Teak, Pyinkado and Pyinma trees left overhead, but, as many of these are not mature, it is not proposed to make the sacrifice merely for the sake of uniformity. All marketable Pyinkado has been marked for felling and will in due course be felled and removed by purchasers.

An abstract of the cost of these operations would perhaps not be out of place :—

	Rs.
Primary Improvement Fellings including Creeper Cutting done in 1910-11 ...	1,631
Secondary Improvement Fellings and Cleanings done in 1911-12	342
Total	1,973

The area of these two Compartments excluding plantations is 662 acres. I estimate that one-fifth of the area consisted of treeless bamboo forest in which nothing was done so that the actual area treated was $662-\frac{662}{5}=662-132=530$ acres.

The cost per acre so far has therefore been Rs. 3-11-6.

5. Moreover, whereas it was noticed that the young Pyinkado was well distributed over the Compartments in areas in which bamboos were absent, in many bamboo areas except along the outer edges where sidelight had penetrated and where clumps had died out after seeding, regeneration was conspicuous by its absence.

6. In some of the untreated bamboo areas the amount of young seedlings was marvellous as the following figures of sample plots counted will show :—

Plot No. 1, area ¼ acre, seedlings found 3,309 or 13,200 per acre.

Plot No. 2, area 1 square chain, seedlings 1,088 or 10,800 per acre.

These two plots have been treated for experimental purposes as follows :—

Plot No. 1—all bamboos were cut down and left lying over the seedlings. Plot No. 2—bamboos were cut and removed outside the area. The plots adjoin each other and have been demarcated with posts and ditches, and it will be interesting to note what the result will be. These plots are typical of a considerable portion of the areas noted in para. 2.

7. Owing to the want of time, before the plants lost their leaves I was able to do very little counting of Sample areas and only managed to count up one other area, and this was a linear survey of 9 chains length covering 1·8 acres counted in Compartment 32, Mokka Reserve, with the following result :—

Seedlings of 1′ height and over	3,691
Poles 8″ to 1′ girth	21
Trees 4′ ,, 5′ ,, ...	2
,, 5′ ,, 6′ ,, ...	2
,, over 6′ ,, ...	2

This is of extreme interest, as showing the almost complete failure of the advance growth to establish itself in the form of trees, and the vast amount of benefit which must accrue from heavy overhead clearances. This sample plot is typical of the dry tree forest known locally as "Thitkyin," which forms the larger portion of the area mentioned in para. 2.

It must not be presumed that this regeneration is something sudden which has recently appeared, on the contrary, where the cover has been light, all classes of trees are represented clearly showing that it has been there always but has not been noticed in the past.

8. Many of the compartments adjoining the areas under report, which fall within the area, over which Karens have the right to cut Taungyas, contain very considerable quantities of Pyinkado, and large patches of "ponso" (or old clearings) were noticed to be full of young Pyinkado, but it is heart-breaking to know that nothing can be done to prevent the sinful destruction of this valuable timber as there is no law to prevent the Ya cutter from felling anything but teak. The writer was able to make some countings in most of the Taungyas cleared last year and the present year with the result that in 38 years with an area estimated at 190 acres, 226 trees with a girth of from 3′ to 14′ were left standing though the majority were dead or girdled. Judging from the surrounding forests the amount of small trees destroyed must have been quite considerable.

In conclusion, I would beg to add that I am very pleased to see that local firms have been making enquiries recently with a view to establishing a saw-mill in the heart of this Pyinkado bearing area. Some 20 miles of fair-weather cart-roads passing through these areas have been constructed under my supervision during the past two years and this will be a great help in carting out sleepers, but I should dearly like to see more money granted for extensions and improvements of these tracks.

T. W. FORSTER,
Extra Deputy Conservator of Forests,
Tharrawaddy Division.

THARRAWADDY:
5th June 1912.

RESIN TAPPING IN AMERICA.

Copy of a letter No. DZ, dated April 10th, 1912, from Professor B. Sudworth, Dendrologist, U. S., Department of Agriculture, Forest Service, Washington, to the Forest Economist, Dehra Dun.

Your communication of March 7th to the Supervisor of the Choctawhatchee National Forest, Florida, U. S. A., has come to our central office at Washington for attention, and in order that you may be put in touch with the firm which is manufacturing

the turpentine cups referred to in the *Indian Forester*, page 450, August 1910, I shall forward your letter to Mr. I. F. Eldrege, Pensacola, Florida, Supervisor of the Florida National Forest, with the request that he send your letter to the manufacturers of the glass turpentine cup in which you are interested. The Forest Service obtained the few cups it used of this type direct from the manufacturers. It will be most satisfactory, I am sure, for you also to deal directly with the makers, as we have no arrangement with them for distributing their turpentine cups.

Since Mr. Woolsey communicated the article referred to in the *Indian Forester* much has been learnt regarding the practical value of this glass turpentine cup. The Forest Service tried a few of these cups on our native *Pinus heterophylla* and *Pinus ponderosa*. *Pinus heterophylla* yields resin copiously under all methods of tapping, and the results obtained with the glass cups were much more striking than those from all other turpentine pines. Our experiments with the glass cup were not extensive, but sufficient to seem to show that in its present form the cup occasions several practical difficulties and would result, it seems, in injurying the vitality of the tree and the quality of the timber (which we always cut into lumber after the trees have been turpentined). It is doubtful, moreover, whether this cup would permit working the trees for as many years and at the same time give as large a yield of resin as other cup systems we use. So far as our experience goes with our native pines, it is absolutely necessary to recut or scarify the original tap wound once a week in order to maintain a continuous flow of resin. This is not easily accomplished with the glass cup, but easily when any of the cup and gutter systems are employed.

I take pleasure in sending, under another cover, Forest Service publications which fully describe the cup and gutter system we have used, and which is now generally adopted by turpentine operators here.

The improved automatically-controlled turpentine "hack," referred to in a footnote in Bulletin 90, we believe is going to give us the most conservative method of turpentining our pines. This

instrument will permit operators to obtain the largest yield of resin with the minimum injury to the timber.

I am personally convinced that any system of turpentining must of necessity provide for a weekly or bi-weekly slight re-cutting or "chipping" of the original wound in order to stimulate the vigorous flow of resin. The first wound made becomes clogged with resin after a week's "run," the flow of resin then being very light. By taking off a thin "chip," a vigorous flow of resin is again stimulated. Moreover, we find by a microscopic study of the wood of trees that are being turpentined that as this wound extends, new or adventitious resin ducts are formed in the wood above the cut as a result of the continued chipping. These added resin ducts give a greater flow of resin than comes from the first tapping.

The inventor of the glass cup seems not to have appreciated the necessity, as it seems to me, of periodic "chipping." His idea was probably that sealing up of the original tap wound (hole), from which the resin is to flow, would ensure a continued flow. So far as I can see this, however, does not take place in practice, for finally the flow of resin becomes less and less. As already stated, the very best results with this cup were obtained in our *P. heterophylla* because this tree does not, as do other turpentine pines, form "scrape" or thickened "gum," even when the wound is exposed to the air, the resin flowing longer without re-chipping. Applied, however, to our principal turpentine pine, *Pinus palustris*, the amount of resin obtainable with this glass cup is very much less and because this tree requires re-cutting at frequent intervals to ensure a continued flow.

THE DIFFERENT FORMS OF PYINKADO.

1. In a note published in the *Indian Forester*, Vol. XXXVII, p. 178, Dr. Percy Groom, pointing out that there were recognisable differences in the structure of the wood believed to belong to *Xylia dolabriformis*, Benth., supplied by the Forest Economist, and which had been collected in Burma and Bombay respectively, raised the

question as to whether these specimens really belonged to the same botanical species. Item 7, Part II, of the Programme of Work prescribed for the Forest Botanist during the period 1910—13 reads as follows :—

" Detailed systematic study and description of all forms of forest plants of economic value, when such is required owing to the commercial importance of the species and to the fact that the existing classification and descriptions are unsatisfactory and confusing." The Forest Botanist accordingly took up the question and in his office circular No. 261/3, dated 5th May 1911 addressed a request to the Chief Conservators of Forests, Burma and Central Provinces, and the Conservators of Madras and Bombay, for any help which it might be possible to afford him in the way of supplying good and complete specimens from all districts where *Xylia* was known to occur. This circular pointed out that the specimens should include " botanical specimens as complete as circumstances permit of leaves, flowers and fruit, great care being taken to clearly number all specimens taken from one and the same individual tree in the same way. Notes should also be given as to the characters (if any) which in the forest are found to distinguish one form from another. The trees from which the specimens are obtained should be numbered in the forest, so that they can be traced subsequently. When all the material submitted has been examined and classified, a few typical trees will be selected by the Botanist and their numbers notified to the local officers for felling, so that representative timber specimens may be obtained for microscopic examination and for testing by the Forest Economist."

In response to this request several Forest Officers have very kindly sent in sets of specimens and the present note is based on a preliminary examination of this material.

2. An important character in the genus *Xylia* is the existence of a gland at the apex of the anther and as this gland is deciduous he character can best be determined in the flower-bud It is a remarkable fact that all the specimens as yet seen by the writer from Burma (from Mu, Katha, Meiktila, Pyinmana, Minbu, Toungoo, Zigôn, Henzada and Ataran Divisions), in which the character

question as to whether these specimens really belonged to the same botanical species. Item 7, Part II, of the Programme of Work prescribed for the Forest Botanist during the period 1910—13 reads as follows:—

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could be satisfactorily determined, show *no glands* on the anthers. On the other hand, all the specimens seen from India (from North Thana and North Kanara in Bombay, from S. Malabar in Madras, and from Balaghat, Bhandara and N. Chanda in the Central Provinces) show a large and perfectly distinct stipitate gland on the anthers. Thus, so far as this character is concerned, there appears to be a real difference between the Burmese pyinkado and the tree of the Indian Peninsula. It is also remarkable that Kurz, when describing the Burmese pyinkado in his *Forest Flora*, Vol. I, p. 419, states that the anthers are *without glands*. Further, it must be noted that Bentham appears to have founded his species *Xylia dolabriformis* on specimens with eglandular anthers and in Hooker's Journal. Bot., IV, 417 (1842) and in the *Genera Plantarum*, I, p. 436 (1865) the anthers are described as eglandular If further study, therefore, proves, as at present it appears probable that it will, that other characters are correlated with that of the gland and that the two trees really are distinct, it seems that the Burmese pyinkado should stand as *Xylia dolabriformis*, Benth., while the tree of the Indian Peninsula would be *Xylia xylocarpa* (Roxb.) = (*Mimosa xylocarpa*, Roxb., in *Cor. Pl.* p. 68 (1795).) In Kew Bulletin, 1909, p. 357, Craib and Hutchinson describe the species *Xylia Kerrii*, based on Kerr's No. 547 from Siam, and which they state differs from *Xylia dolabriformis*, Benth., in having eglandular anthers and the mature leaves pilose below.

Xylia Kerrii, Craib and Hutchinson, was also described in *Hooker's Icones*, *t.* 2932 (1911) and Lace's No. 2780 from Tharrawaddy (of which Mr. Lace has very kindly presented a sheet to the Dehra Herb.) was then included in the species, thus extending its area of distribution to Burma.

Specimens recently received at Dehra Dun, however, have shown that the mature leaves of trees with eglandular anthers may vary from glabrous to densely pubescent or hirtellous below and that the hairiness of the mature leaves does not therefore always separate the eglandular from the glandular forms.

The hairiness below of the mature leaves in the Burmese tree, moreover, from the specimens received to date, appears to be a

character of little, or at most of only varietal, importance. The hairiness in some cases varies considerably on the same tree, while numerous intermediates unite the glabrous with the densely hairy forms. The former seem to prevail in œcologically moist localities (*e.g*, South Henzada, Moulmein and Katha), while the latter are found in relatively xerophytic habitat (*e.g.*, Zigôn, the *hills* of North Henzada and the *ridges* of Toungoo). It is hoped that local officers may be able to supply further information regarding this point.

2. There is, however, no doubt that the Burmese pyinkado is a very variable tree, and the following interesting note drawn up by Mr. C. W. Allan, Extra Deputy Conservator of Forests, Henzada Division, on three forms which are locally distinguished, has recently been received by the writer through the kindness of Mr. J. H. Lace :—

"The three kinds of Pyinkado :

(1) *Pyinkado-wa* or *yellow pyinkado.*

(2) *Pyinkado-ni* or *red pyinkado.*

(3) *Pyinkado-net* or *black pyinkado.*

(1) The *Pyinkado-wa* or *yellow variety.*—In this variety the heart-wood is of a yellowish-brown colour, hence the name. The leaves and seed pods are longer than in the other two varieties. The flower is also larger. It is found away from the hills, chiefly where the soil is moist. The tree splits in felling and the timber cracks and warps very considerably after sawing. The fibre on the longitudinal section is not so wavy as in the other two kinds. The Burmans do not fancy it for building purposes and will not use it where either of the other two kinds can be had. The wood is not hard.

(2) The *Pyinkado-ni* or *red variety.*—In this variety the heartwood is of a reddish-brown colour. The leaves, flowers and seed pods are smaller on laterite soil and "Indaing." The tree does not split on felling and the wood does not warp or crack very much after being converted. The fibre on the longitudinal section is wavy. It is heavier than (1) but lighter than (3). The Burmans like it for building purposes. Wood is moderately hard.

(3) The *Pyinkado-net* or *black variety*.—In this variety the heart-wood is of a very dark-brown colour and is extremely hard. The leaves, flowers and seed pods are very much smaller than in either of the other kinds. It is found chiefly in the hills, also in "Indaing" with a laterite soil. The tree does not split in felling and the timber does not warp or crack very much after conversion. The fibre on the longitudinal section is wavy. It is heavier than the other kinds and is considered the very best for building purposes The botanical specimens received from Henzada show (1) a form with mature leaves strongly hirtellous mainly on midrib and lateral nerves below, (2) a form with mature leaves densely pubescent below, and (3) a form with mature leaves glabrous below, but unfortunately the notes sent do not describe the timber of these forms.* In Pyinmana two forms, as follows, are reported to be locally distinguished :—

Red pyinkado :—leaves large, bark red, rough, heart-wood large, comparatively easy to saw.

White pyinkado :—leaves small, bark white, smoothish, heartwood smaller but harder and not so easy to saw.

From the specimens sent in, the leaves in both these forms are, apart from size, very similar and are more or less pubescent below, especially on the nerves. Further specimens have been asked for in the hope of finding some additional definite morphological characters which can be correlated with the above. There is believed to be no difference in the *colour* of the timber of these two forms.

It is probable that further enquiry will bring to light considerable variation also in the Indian tree.

4. For the correct definition and co-ordination of the recognisable forms, however, considerable further study is required involving, among other things, a study of the 7 odd species

* Further specimens, received since the above was sent to Press, have shown that there is practically no difference, as regards the hairiness of the mature leaves, between the *yellow*, *red* and *black* forms, while in one and the same form the mature leaves vary from practically glabrous to densely pubescent below.

belonging to the genus which have been described from Africa and Madagascar and an examination of more complete material than is yet available at Dehra Dun. The object of this note, therefore, is not to publish final conclusions, but to (1) draw attention to the interesting and important character of this enquiry; (2) heartily thank those Forest Officers who have very kindly contributed specimens up to date, and especially Mr. J. H. Lace, Chief Conservator of Burma, Mr. F. A. Leete of Pyinmana Division, Mr. C. B. Smales of Zigôn Division, Mr. H. R. Blanford of Katha Division and Mr. F. Ryan of Meiktila Division, all of whom have contributed splendid sets of specimens; (3) ask for the continued co-operation of all Forest Officers in *Xylia*-producing districts in obtaining the specimens and information which are still required in order to complete this work; and (4) point out the urgent need of good specimens from Madras, Bombay and the Central Provinces to supplement the material received from Burma, the specimens of the Indian tree at present available being very meagre.

5. In anticipation of such co-operation attention is drawn to the following points:—

(*a*) It is particularly requested that no trouble be taken to *mount* the specimens submitted. From a few districts mounted specimens have been sent in which have usually been reduced to comparatively valueless scraps in the effort to make the specimens fit neatly on the mounting-paper, while the fact that such specimens are gummed to the paper interferes with their satisfactory examination.

(*b*) The following are now particularly desired:—

Several good flowering twigs, *several* twigs with good specimens of mature leaves (indicating especially differences of size, shape, texture and hairiness) and *several* ripe fruits from *each selected individual tree* in all districts where these specimens have not yet been collected. Such specimens will give a good idea of *individual* variation in flower, leaf and fruit

which is indispensable for a sound description and classification of the various forms.

(*c*) It is desirable, as far as possible, to correlate the ordinary botanical characters with the characters of the wood, and notes should therefore be sent with all specimens, indicating any differences locally recognised in the quality of the wood of the various selected trees. Notes should also be given regarding the class of forest and type of locality in which the different forms are usually found.

(*d*) As the glands on the anthers are best seen in the bud, the flowering twigs should include some immature heads in which the flowers have not yet opened.

As fallen flowers are usually more or less damaged by insects they should only be sent when no others are obtainable.

R. S. HOLE.

5th July 1912.

PROGRESS OF FORESTRY IN GREAT BRITAIN.

The Universities of Oxford and Cambridge have received the following communication from the Board of Agriculture and Fisheries, London :—

BOARD OF AGRICULTURE AND FISHERIES,
4, WHITEHALL PLACE,
LONDON, S.W.
25th March 1912.

SIR,

I am directed by the Board of Agriculture and Fisheries to send to you, for the information of the Universities of Oxford and Cambridge, copies of a memorandum giving particulars of a grant made to the Board by the Treasury on the recommendation of the Development Commissioners for the purpose of enabling certain Institutions in England and Wales to supply technical advice in forestry to landowners and other persons interested, and I am to inquire whether the University would be prepared to undertake the provision of work of this character on the lines indicated in the memorandum, and in accordance with the conditions set forth therein.

If the University is prepared to accept this proposal, I am to say that the Board will be willing to make a grant not exceeding £500 *per annum* for three years from the 1st October next to *provide for the salary and travelling expenses of an advisory expert.* The grant will be subject to the *proviso* that *the total expenditure of the University for this purpose,* less any receipts from fees or other sources, *is greater than the amount of the proposed grant,* and it will be necessary that a certified statement of income and expenditure in connection with the work for the twelve months ending September 30th, should be furnished annually to the Board, together with the necessary vouchers for payments. Payment will be made as soon as possible after the receipt of this statement, but, if necessary, a payment on account would be made in the course of the year.

* * * * * *

The Board will be glad, however, to be furnished with your views on the suitability of the area suggested.

I am, Sir,
Your obedient servant,
T. H. ELLIOTT.

(1) Oxford; (2) Cambridge; (3) Gremester Agricultural College; (4) Bangor; and (5) Armstrong College.

THE MEMORANDUM ABOVE REFERRED TO.

Grant from the Development Fund in respect of Provision of Technical Advice in Forestry.

Owing to inadequate resources, Institutions possessing Forestry Departments have hitherto restricted their attention for the most part to imparting instruction to students. It is now proposed to attach an experienced forest expert to the Forestry Departments of two Universities and three Colleges, whose chief duty will be to supply to landowners and others advice as to the general and detailed working of their woods. Each Institution will, therefore, become for a given district, a centre for information, to which application may be made on all questions relating to the formation, treatment, utilization, and protection of woods.

It is essential that the staff to be employed in advisory work should command the confidence of landowners. The men selected should, therefore, be well acquainted with the practice and theory of forestry both at home and abroad. They should be prepared to study in detail the local conditions in their districts, and they must endeavour to impress the advantages of systematic management on those owners of woodlands with whom they come in contact.

In order to provide the data which are necessary for the foundation of efficient forest management the Board propose, with the co-operation of landowners, to establish a number of experimental plots dealing with the thinning, underplanting, and regeneration of woods. It will be one of the duties of the forest experts to be appointed by means of the Grant to aid the Board's

officers in the selection, treatment, and supervision of these plots, and in the collection of such statistics as may, from time to time, be required.

Conditions of Grant.

1. A grant of £500 per annum for three years from 1st October 1912 will be made to each of five Institutions to provide the salary and travelling expenses of an advisory expert.

2. The grant in each case will be a grant-in-aid only. It must be used for the purpose of developing advisory work, and must not be used for the purpose of reducing existing expenditure.

3. It will be open to an Institution to employ a member of the present staff on advisory work, but in that case his place must be filled by a fresh appointment to the teaching staff.

4. The Board will require to be satisfied that the officers whom it is proposed to employ on advisory work possess the necessary qualifications. Where advice of minor importance is sought the case may be investigated by a junior officer, but in all cases the advisory officer must be responsible for the advice tendered.

5. Advisory officers may undertake a limited amount of teaching on condition that other members of the staff give an approximately equivalent time to advisory work.

6. The advisory staff will be expected to co-operate with the Board's officers both in experimental work and in the making of enquiries.

7. Each Institution in receipt of a grant from this fund will be expected to undertake the advisory work in a group of counties.

8. An Institution may, where this course appears to be desirable, charge a fee in respect of advice tendered under the scheme. The charge may not exceed one guinea per day for each day's work in the field.

9. The advisory officer must supply to the Board a duplicate copy of the reports sent to persons seeking advice, or where verbal advice only is given a short statement of the case and of the advice given should be sent.

Both the Universities of Oxford and Cambridge have decided to accept the offer made by the Board of Agriculture. The University of Oxford too decided to appoint an expert with a salary of £400 per annum, whilst in the case of the University of Cambridge the salary of the advisory expert be fixed at £300. This would leave £100 in the one case and £200 a year in the other case towards the travelling expenses entailed by the advisory work in the counties mentioned above, which the Committee recognise to be a suitable area.

Oxford and Cambridge are now advertising for experts.

HOT WEATHER SAING SHOOTING IN UPPER BURMA.

(Bos Sondaicus, Burmese vernacular Saing, peculiar to Burma and Malay Peninsula.)

For those not prepared to face insect pests and the usual discomforts of a rain trip, perhaps the best time, for securing a Saing head, is during the hot season. For a forest officer, moreover, it is often the only time, provided always his fire-protection and other inspection works allow of a few days' halt near Saing country. Saing country *par excellence* is dry open forest of 'in' *(Dipterocarpus tuberculatus)* known throughout the country as 'indaing,' in which large patches of grass (kwins) are interspersed. At the end of March or early in April, both the 'indaing' and the 'kwins,' unless fire-protected, are usually burnt and in some cases buffalo graziers fire the 'kwins' earlier in order to procure good grazing for their herds. The young grass which springs up thickly over the fired 'kwins' proves irresistible to the Saing and when it has reached a height of six inches to a foot one may be tolerably certain of finding these animals grazing at sunrise and sunset. In failing light however accuracy in shooting cannot be depended upon and in addition a wounded beast cannot be tracked down and quickly despatched; so that it is fairly obvious that an early morning start is indicated. Conditions of course vary considerably in different localities and I propose attempting to describe now a successful morning that recently

fell to my lot whilst touring in the division in my charge. My 'lugale' (bearer I think he is called in India) reluctantly woke me at 3 A.M. and after 'chota hazri,' or to be more accurate, a good solid breakfast, I left the camp preceded by a man with a hurricane lantern and followed by my tracker and a man carrying a spare rifle. After a tramp of 3 miles along a very ill-defined foot-path it became light enough to send the lantern bearer back and we found ourselves on the edge of a small 'kwin.' Except for a solitary pig that walked off slowly as we skirted the edge of the 'kwin' no animals were to be seen. Cutting across a patch of jungle to the next 'kwin' another blank was drawn and before striking any fresh tracks I must have scanned round at least a dozen 'kwins.' However, at about 8 A.M. we reached one in which the herd had evidently been grazing that morning and following the tracks we were taken off into a patch of jungle that had not been burnt. The dry 'in' leaves completely covered the ground and it was hopeless for even the best of trackers to continue as there was little or no dew and the herd had traversed the patch more than once during the previous few days. The tracker said he knew to which 'kwin' the herd had moved off and accordingly we went for about a mile further and came up to a herd of domestic buffaloes grazing inside a burnt patch of jungle. Approaching these we saw the Saing herd on the far side standing still, preparatory to taking a siesta. When within 200 yards of the Saing, the buffaloes still intervening, two or three of the herd had lain down, and we also had to do the same as the buffaloes had seen me and in their usual inquisitive if not aggressive manner were making towards me. It seemed likely they would come nearer and then rush off and alarm the Saing, but lying low my tracker judiciously aimed a few small lumps of earth at the nearest and made them sheer slowly off. As soon as the buffaloes had allowed a clear approach a 'gyi' (barking deer) passed just in front but fortunately did not see us.

By crawling on hands and knees over hard but level ground for about 80 yards and squirming full length along the ground for another 20 I got to within 100 yards of the bull who was lying

down. As is invariably the case with a herd at rest, however, a cow was standing near by on the *qui vive* and she got restive. The bull then stood up, saw me but didn't quite know what to make of it and started to trot towards me. I then got a shot but he turned and went off at a good pace permitting a raking shot with my second barrel. He dropped stone dead about sixty yards further on and when I got up I found the first bullet ('450 solid nickel high velocity cordite), had entered the left centre of the chest, gone right through the body and grazed the inside of the left thigh on coming out. The head was only a moderate one, but the tips of the horns were not frayed off as is so often the case with old bulls.

I was back in camp soon after 10 A.M., and by noon not a vestige of the carcase remained in the forest, what my own camp followers had not torn into shreds and hung up to dry in the sun being quickly disposed of by the otherwise vegetarian villagers.

Blank days are not infrequent especially in country that has a reputation for holding big game. On one occasion I had the good fortune to find an old grey bull, cow and calf grazing in an open 'kwin' soon after 5 o'clock in the morning. Stalking to within range occupied about ten minutes after which, just as I was about to take aim, a barking deer I had not seen sprang up and barking for all he was worth gave the alarm to the Saing who were off immediately. We tracked them for four hours but never got another glimpse, and I returned to camp well after noon none too pleased with my luck as the bull appeared to have as fine a head as I have seen. On other occasions nothing has been seen at all though once I came up with a herd of seven cows and two calves without a bull of any size among them. This, perhaps, was not strange since I know that no fewer than eight bulls fell to one gun in this neighbourhood last season. There is unfortunately no limit to the number of head that one person may shoot in a season in Burma—a state of affairs which in the writer's humble opinion should be allowed to continue no longer.

J. D. C.

EUCALYPTUS OIL.

Enormous quantities of Eucalyptus oil have been consumed in the Australian mining districts in the processes of preparing sulphides of zinc and lead. About one-half pound of oil is emulsified by vigorously shaking it up with 100 gallons of water, and *with this mixture the moistened or powdered ore is stirred up.* The Eucalyptus oil absorbs the sulphide particles and carries them to the surface, together with the gold and silver contained in them, up to 25 per cent. of the actual content of the powdered ore being recovered by the process.—[*Capital.*]

DURABILITY OF WOOD CUT IN SPRING AND IN SUMMER.

Timber cut in spring and in summer is not so durable as that cut in winter, when the life processes of trees are less active. Scientific investigations sustain this statement. The durability depends not only upon the greater or less density, but also upon the presence of certain chemical constituents in the wood. Thus a large proportion of resinous matter increases the durability, while the presence of easily soluble carbo-hydrates diminishes it considerably. During the growing season the wood of trees contains sulphuric acid and potassium, both of which are solvents of carbo-hydrates, starch, resins and gums; they are known to soften also the ligneous tissue to a considerable degree. During the summer

months the wood of living trees contains eight times as much sulphuric acid and five times as much potassium as it does during the winter months. The presence of these two chemical substances during the growing season constitutes the chief factor in dissolving the natural preservatives within the wood and in preparing the wood for the different kinds of wood-destroying fungi, such as *Polyporus* and *Agaricus*. The fungi can thus penetrate more quickly and easily into the interior of the wood when these wood gums are already partly dissolved and available for their own immediate use. From this stand-point it seems that the best time to cut down the tree is in the winter when sulphuric acid and potassium are present to a much smaller degree, and the fungi will not be assisted in dissolving the natural preservatives in the wood. The amount of wood gum is always less and more easily soluble in sap-wood than in heart-wood and for this reason the former is usually regarded worthless for industrial purposes.—[*Scientific American.*]

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INDIAN FORESTER

OCTOBER, 1912.

LIST OF THE TREES, SHRUBS AND ECONOMIC HERBS OF THE SOUTHERN FOREST CIRCLE OF THE C. P.

Prefatory.

An Introduction to a Forest Flora, or even a mere list of plants, is best prepared after all the available information contained in the list itself is to hand. As this is not yet the case with regard to the list of the Southern Circle, it is not proposed to do more at the present stage than offer a few prefatory remarks which have for their object the remedy of that very incompleteness which renders an Introduction at this stage inadvisable.

Until 1906 C. P. Forest Officers had no list of their important trees and shrubs except in the form of some appendices to Working Plans. Some of these were very incomplete or even inaccurate, others, like that prepared by Mr. Clutterbuck for Allapalli, exceedingly useful for the limited area with which it dealt.

In 1906 Mr. Hole, now Botanist at the Forest Research Institute, Dehra Dun, brought out a most useful list of the Trees, Shrubs and Climbers found in the Northern Forest Circle of the

Central Provinces which was reviewed in the *Indian Forester* in April 1907. This was followed up in 1908 by Mr. Witt's list of Trees, Shrubs and Climbers and other plants of economic importance found in the Berar Forest Circle which has been found of the greatest use not only in Berar but in parts of the Southern Circle. This was reviewed in the *Indian Forester* in May 1909. Mr. Hole did not pretend that his list was complete and only referred to it as a preliminary list. It was left to other Forest Officers to amplify it and send to him addenda as new species or localities were successively ascertained. The list now being prepared for the Southern Circle, it is desired, should be made complete before separate publication in book form, by the co-operation of all Forest Officers in the Circle, whose further contributions to the Flora the Editor has kindly consented to publish periodically in the pages of this journal. There are some Forest Officers in the Circle, or but lately left, who have a very thorough knowledge of the trees in their divisions together with their vernacular names, and Mr. Donald, a botanist as well as forester, has, I believe, already made a very complete list of the important South Chanda Flora (still in manuscript). With the aid of these officers and any other botanists outside the department who may be willing to help, it is hoped that an accurate list of vernacular and other names may be compiled, together with the chief localities and uses of the plants concerned.

With regard to these vernacular names it is hoped that some attempt will be made to indicate the language. This matter appears of greater difficulty in the C. P. than in other Provinces with which the writer is acquainted who is himself handicapped in the matter by ignorance of the C. P. dialects, but the difficulty should not be insuperable. Where the language is not known it is desirable to indicate the district.

A few Kol names are found in the extreme east, but the transfer of many of the small Native States to Bengal has removed nearly all the Kolarian element. The Baiga names seem very peculiar as they resemble ordinary Hindi, Gondi or Kol names applied to *other trees.* Thus they call the Toon, Lim or Mahalim

which induced some officers to take it as Ailanthus and they call *Acacia lenticularis*, Khair!

The following abbreviations have been adopted for names of languages and districts or forest divisions :—

Bal.	Balaghat.
Bil.	Bilaspur.
Bhan.	Bhandara.
N. Ch.	North Chanda.
S. Ch.	South Chanda.
N. Ward.	Nagpur-Wardha.
Rai.	Raipur.

H., Hindi; Gond. or Gondi; Mar., Marathi; Chh., Chhattisgarhi; Baig., Baiga; Tel., Telegu; Bhum., Bhumia; Maria.

Where possible I have utilised the lists of trees drawn up in the following Working Plans and have adopted the vernacular names given. This has not been possible with doubtful species, *e.g.*, *Miliusa* is often confused with *Saccopetalum*, *Dillenia aurea* has been mixed up with *Dillenia pentagyna*, etc., etc. Where names are taken from Working Plans the abbreviation W. P. is added after the division. The lists consulted were drawn up by the following officers :—

Balaghat (Baihar and Raigarh)—Mr. Percival.
North Chanda—Messrs. Lowrie, Lemarchand and Langhorne.
South Chanda (Allapalli)—Mr. Clutterbuck.

H. H. HAINES.

I.—RANUNCULACEÆ.

So far neither **Clematis** nor **Naravelia** have been recorded but **Clematis** is common in Pachmarhi and is also found in Nimar. It will probably occur in the Maikal Hills.

II.—DILLENIACEÆ.

Dillenia aurea, *Sm.* Kalli, *Baiga*; Kalla, Karmata, *Gond*; China Kalanga, *Tel.*

A small crooked tree with large leaves which have a distinct petiole 1—3" long. Fls. large yellow, *April—May*. Fr. *May—June*. The fruits are eaten.

Found in all divisions and will almost certainly occur in the Northern Circle. Common in the Harratema and Balabehra forests in Raipur. Both above and below the ghat in Bal. On white clay schists, Kukra, (Dhansua Range, Bal.). Chhaparwa to Lamni common, Lormi forests and Pantora Range, (Bil.), Elchil (S. Ch.). Most frequent on metamorphic rocks especially clay schists.

Dillenia pentagyna, *Roxb.* Kalla, Kalli, *Gond*; Mirchi, *Baiga*; Pedda Kalanga, *Tel.*; Kankera, *Mar.*

A straighter tree with even larger leaves and short amplexicaul petiole. Fls. yellow medium in clusters on the bare branches. Fls. *March—April.* Fr. smaller, eaten, *May*.

Less common and requiring moister localities.

Bal.:—in valleys, Batkari, Nahara valley (Dhansua Range) Dhiri-Mangli. Bil.:—Lormi forests (Chhaparwa, etc.), Sonakhan Range, Rai.; Elchil (S. Ch.); Durgapur, Moharli Range (N. Ch.). Cut back by frost at Kara (Dhansua Range, Bal.) where both **Dillenias** are found in association.

III.—ANONACEÆ.

Polyalthia cerasoides, *Benth. & Hook.-f.*

A small straight tree with numerous spreading branches, distichous lanc. or oblong lanc. pubescent leaves and usually solitary axillary greenish fls. on the new shoots. Fruit an umbel of red fleshy carpels.

Fls. *April—May*. Fr. *May—August.* Evergreen.

A tree of the moister forests only, Amjhar nala, Kanhargaon, Harunpaili Block, etc. (S. Ch.); Haveli Range (N. Ch.).

Polyalthia longifolia. *Benth. & Hook. f.* Debdar *H.*

Sometimes also called Asok, a name also applied to **Saraca indica**. A straight tree with long narrow shining undulating leaves, often planted.

Miliusa velutina, *H. f. & T.* Dom sal, Kari. *H.*; Karli, *Gond*; Pedda chilka duduga *Tel.* (*S.-Ch.-W.-P.*)

A tree rarely over 3 ft. in this Circle with large ell. or ovate leaves 4 to 10" long more or less permanently pubescent beneath. Fls. green on long drooping pedicels, on new shoots. The bark is usually pale and fluted. Fls. *May*. Fr. *June*. Deciduous. Fairly common in the damper forests of Balaghat, Baihar Range, Sulsuli, etc., Pantora Range, (Bil.) frequent.

Saccopetalum tomentosum, *H. f. & T.* Kari *H.*

Thoska, *Gondi*; Kutki, *Gondi* (Bal. W. P.); Chilka dudi, *Tel.* (S. Ch. W. P.)

A tree rarely over 4 ft. in this Circle with ovate-oblong somewhat aromatic leaves rarely exceeding 6" pubescent beneath. Fls. purple on slender pedicels. Fr. an umbel of black fleshy carpels.

Fls. *May—June.* Fr. *June—July.* Deciduous.

Common in all divisions. The wood is valued for house poles.

Anona squamosa, *L.*

The custard apple is cultivated as also, to a small extent, is **Anona reticulata,** *L.* The Bullock's Heart.

IV.—MENISPERMACEÆ.

All climbers with palmi nerved leaves.

Tinospora cordifolia, *Miers.*, Gulbel, *Mar.*

Climbing shrub with succulent corky stems, entire cordate leaves and minute yellow fls. in racemes longer than the leaves. It sends down numerous long fleshy slender roots from the branches. Fls. *August—October.* Only seen near tanks, Nagpur-Wardha.

Cocculus villosus, *D. C.*

A slender grey villosely tomentose climber with deltoid to ovate-oblong obtuse leaves attaining 3" by 2" and axillary small

capitate cymes of minute fls. Druplets dark purple. Common everywhere in hedges, etc. Fls. *November—February.* Fr. *April.*

Cissampelos Pareira, *L.* Pahadmul, *Mar.;* Kurupahad *Gond.*

A slender climber with slender rhizomes to which it often dies back in the hot weather. Leaves often broader than long and usually peltate. Fls. minute. Male in corymbose cymes and Females in the axils of large bracts in racemes. Common. Fls. *June—October.* Fr. *November—January.*

V.—CAPPARIDACEÆ.

Crataeva religiosa, *Forst.* Uskeman, *Tel.*

A small tree with 3-foliate leaves and yellow and white flowers in corymbs. Fls. *March—April* with a new foliage. It is sometimes cultivated in gardens, and is entered as wild ("a moderate sized tree with 3-foliate leaves") in the Moharli W. P. under the name of Karangi pipal. Wild and sub-gregarious at Patanil (S. Ch.) fide Donald.

Capparis, grandis, *L. f.* Pachara. *Mar.;* Regguti (*N. Ch. W. P.*)

A small tree with pubescent often drooping branches, sometimes thorny. L. broad 2—3", often roundish. Fls. $\frac{3}{4}$—1" diam. white, *Oct.*

N. Ward. (Bapuwara forest); North Chanda; usually on cotton soil.

Pieces of its wood are strung together through the pith and worn as a charm.

Capparis horrida, *L.* Waghoti, *Mar.;* Reguti, *Tel.* (*S. Ch. W. P.*); Ketauni (N. Ch. W. P.).

A scrambling or climbing shrub with rusty pubescent shoots and stout recurved thorns. Fls. above the axils, white to pink, sub-solitary or several in vertical lines. Berry $1\frac{1}{2}$" long. Fl.—*March April.* Fr. *June.*

All divisions, frequent.

Capparis sepiaria, *L.*

A straggling or climbing shrub with pale grey branches and recurved thorns, small white flowers in umbels and small black berries, size of a small pea.

Pipalkhot (N. Ch.,) Dhaba Range (S. Ch.)

Fl. *Nov.—Dec.*

VI.—BIXACEÆ.

Cochlospermum Gossypium, *DC.*

Galgal, *H.*; Gongal, *Mar.*; Ganeri, *Bhum.*; Konda gogu *Tel.* (*S. Ch. W. P.*)

Small tree with light fluted bark and spongey wood. Large yellow fls. while leafless, and palmately lobed leaves.

Dry localities. All divisions, common.

Fl. *January—March.* Fr. *March—June.*

Flacourtia Ramontchi, *L'Herit.*

Kakai, *H.*; Gandregu, *Tel.* (*S. Ch. W. P.*); Kanki, Katian, *Gondi* (*Bal. W. P.*)

A small tree or shrub, usually thorny, with crenate-serrate leaves and yellowish green one-sexual flowers ¼″ diam.

Fruit a red berry ⅓″ to ½″ diam., edible.

Fl. *December—March.* Fr. *April—May.*

Common in all divisions. Frequent as a shrub in scrub jungles.

VII.—POLYGALACEÆ.

Polygala chinensis, *L.* Bijnori, *Gond.*

A small plant 3—5″ high leafy especially towards the top, with pubescent stem variable leaves 1½ to 3½″ long and terminal and lateral capitate or sub-capitate racemes of greenish or pink zygomorphic flowers. Capsule 2-seeded membraneous. Fl. *June* to *November.*

The dried roots come into the market as cylindrical brown and wrinkled pieces about ⅓″ diam. It is included in some of the leases for Minor Forest Produce.

Specimens received from Messrs. Beechey & Cole.

VIII.—TAMARICACEÆ.

Tamarix ericoides, *Rottl.* Jhao, *H.*, *Mar.*

A shrub with erect branches clothed with minute sheathing amplexicaul leaves and with 2-sexual pink flowers in terminal racemes.

River beds, frequent. Katangi (Bal.). Belda (N. Ward.), etc.

Fl. Fr. *October—August.*

IX.—DIPTEROCARPACEÆ.

Shorea robusta, *Gaertn.* The Sal tree.

Sarai, *Gondi ;* Pinjal, *Gondi* (Bal. W. P.)

Bastar, Bil., Bal., Rai., usually following the line of the metamorphic rocks. Not found in the driest localities. It suffers from frost in some of the valleys of Baihar, Raigarh and Lormi Ranges.

X.—MALVACEÆ.

Malvastrum tricuspidatum, *A. gray.*

An undershrub with straw yellow flowers liable to be mistaken for **Sida** from which it may be easily distinguished by the bracteoles.

N. Ward. An introduced plant.

Sida veronicaefolia, *Lamk.*

An undershrub 1—3 ft. high (or sometimes herbaceous and procumbent) with sub-orbicular or ovate cordate leaves and pale yellow flowers on slender peduncles without bracteoles.

In all divisions. Fl. cold season, and also sporadically throughout the year.

Yields a fibre.

Sida glutinosa, *Roxb.*

Similar but taller and distinguished by the dense glandular hairs. Surera (N. Ward.), etc. Less common. Fls. *Aug.—Dec.*

Sida spinosa, *L.*

With cordate pubescent leaves and *1—3 spiny tubercles below* them.

Fls. *Aug.—Oct.* Common.

Sida cordifolia, *L.*

An erect undershrub 2—4 ft. tomentose all over with ovate cordate obtuse leaves and straw coloured fls. ½" diam. Carpels with long awns.

Fls. *Aug.—Dec.* Fr. *Oct.—Jany.*

Sida rhombifolia, *L.*

Undershrub 1—4 ft. with thin or thick stellate hairs on the branches and rhomboid or obovate leaves with cuneate 3-nerved base.

Very common but especially in open situations in the rains and cold weather.

Sida acuta, *Burm.*

Undershrub 2—3 ft. high with very tough sparsely stellate hairy stems and lanceolate to ovate-lanceolate serrate glabrous leaves 1½—3½" long.

Waste ground, common. Fl., Fr. *Aug.—Dec.*

All the **Sidas** yield fibre.

Urena lobata, *L.*

Undershrub 2—4½ ft. high with sub-orbicular angled or slightly lobed leaves and pink flowers ¾" diam., not racemose. Carpels glochidiate. Very common.

Fl., Fr. *Aug.—Dec.*

Urena sinuata, *L.*

Similar but the leaves cut beyond the middle into usually 5 oblong or lanceolate segments.

Fls. 1" diam.

Frequent, in all divisions.

Urena repanda, *Roxb.*

Shrub 2—4 ft. with roundish leaves 2½—3½" diam. and pink flowers ½—1" diam. which are axillary and racemed. Carpels smooth.

Fl. *Sep.—Oct.* Fr. *Nov.—Dec.*

Glades in the forests. Bil., Bal.

Probably in all divisions.

Pavonia zeylanica, *Cav.*

An undershrub 3—4 ft. with hoary pubescent stems, lower leaves 4—5 diam. with 3 large acuminate lobes and rounded cordate base, upper lanceolate, all more or less dentate-serrate. Fls. 1½" diam. with linear bracteoles and large calyx, easily distinguished in fruit by the netted winged carpels. Fl. *Oct.* ? Fr. *Dec.—Jany.*

Pantora Range, Bilaspur, on the hills.

Abutilon indicum, *G. Don.*

An undershrub covered with a soft white close velvet with few or no long hairs. Fls. orange 1" diam.

Head of many carpels truncate.

Fl. r. s. and up to *December.*

Frequent, but rather local and often near villages. N. Ward.

Abutilon muticum, *G. Don.*

4—6 ft. high with the stems and petioles densely villosely hairy, round cuspidate leaves softly white tomentose beneath and closely more roughly tomentose above, dentate to denticulate. Fls. orange usually on short axillary branches running out into terminal panicles. Sep. cuspidate. Carpels many, pubescent Umrer Range, (N. Ward.) Fr. *Sept.* Ft. *November.*

Abutilon graveolens, *W. and A.*

Stouter than the last, 3—6 ft. high, covered with a velvety tomentose with glandular pubescent and long soft hairs intermixed. Fls. 1½" orange with a crimson centre. Similar localities. Raipur.

Hibiscus Solandra, *L'Her.*

About 3 ft. high with polymorphous leaves lower simple or 3-lobed always with sub-cordate base and coarsely toothed, upper

3-lobed or 3-sect or small and simple. Fls. not seen, they are yellow according to F. B. I. but white and only ¾ to ½" diam. in the Pachmarhi plant, on long peduncles 1—2" long jointed above arranged in loose often corymbose racemes. Capsule slightly exceeding the ·3" long calyx 5-valved, cuspidate, sutures ciliate with bristles.

Sihawa Forests (Rai.) Fl. *Sep.—Oct.* Fr. *Nov.*

(*Note.*—Roxburgh correctly describes the flowers as white under his H. pumilus.)

Hibiscus panduræformis, *Burm.*

A tall herb up to 10 ft., lower leaves irregularly lobed, upper narrow, all coarsely irregularly toothed.

Fls. axillary and in terminal racemes 1—1·25" yellow subsessile Bracteoles linear spathulate connate at base. Rai.; N. Ward. Fls., Fr. *Nov.—Jany.*

Hibiscus cannabinus, *L.*

A tall herb with large leaves of which the upper are deeply palmate. Fls. large over 2" diam. white (rarely slightly yellow) with purple centre.

Cultivated, especially on rice lands, for its fibre.

Hibiscus Sabdariffa, *L.* Rozelle.

Shrubby. Glabrous except the flowers and fruit. L. with petiole often longer than blade which has a gland on midrib. Fls. 2½" on very short peduncles. Bracteoles accrescent with calyx at base. Commonly cultivated on cotton soil. Fls. c.s.

Hibiscus ficulneus, *L.* Ran bhendi, *Vern.*

3—4 ft. Stems nearly smooth or scabrous with tubercle based hairs or prickles. L. sub-orbicular very deeply 3—5 lobed with the lobes constricted at base.

Fls. white to pink in more or less leafless racemes.

Fls. *Sep.—Nov.* Fr. *Nov.—Dec.*

Lohara, Balod Range (Rai.); N. Ward.

Probably all districts.

Hibiscus cancellatus, *Roxb.*

A very hirsute or bristly herb with lower leaves sub-orbicular, large yellow fls. (with purple centre) on peduncles about 1" long in terminal racemes (and few axillary). Capsule sub-globose to oblong 1—1·75" hirsute with yellow hairs. Bracteoles persistent filiform. Rai.; Bil.; Bal. Fl. *Aug.—Nov.* Fr. *Oct.—Jany.*

Hibiscus esculentus, *L.* Bhendi, *Vern*

Erect 4—6 ft. Capsules long oblong.

Often cultivated.

Hibiscus rugosus, *Mast.* Pahari Bindi, *Vern.*

Recorded in "Wild Plants found in Nagpur" by Mr. Graham.

Thespesia Lampas, *Dalz.* Jungli Bendi, *Vern.*

A stout undershrub 4—6 ft. high with large yellow flowers and crimson centre. Two species are distinguished in the Addenda to the "Forest Flora of Chota Nagpur":—

(*a*) L. glabrescent and glaucescent beneath mostly deeply 3-lobed with very acute or acuminate lobes. Capsule 3-rarely 4-valved, oblong ·6—·8" cuspidate, readily dehiscent.

Common in all divisions.

(*b*) L. stellately tomentose beneath mostly simple and entire or with shallow blunt lobes. Capsule 5-rarely 4-valved, ·7"—1" broad ovoid blunt, tardily dehiscent, woody.

This has only been noted from South Chanda.

Both species and varieties fl. r.s. up to *October* and fr. c.s.

Kydia calycina, *Roxb.* Banga, *Gond* (Chh.?); Baranga, *H.*; Potri marra, *Gondi*; Botki, *Tel.* (S. Ch. W. P.)

The names Dhaman and Bhoti are often given from confusion with other trees.

A tree, small to m. s., with sub-orbicular palmately 5—7 nerved leaves, with a gland on 1—3 of the nerves beneath.

Fls. m. s., white in panicles from *Sept.* to *Nov.*, conspicuous in fruit from the 4—6 persistent spreading bracteoles.

Common in all divisions.

Bombax malabaricum, *DC.* Saori, *Mar.*; Burga marra, *Gondi* (S. Ch. W. P.); Burka burgee, *Tel.* (S. Ch. W. P.) Simar, Semal, *H.* Silk cotton tree.

A well known tree of which a nearly spineless variety with smaller deep red flowers is common in the C. P.

It grows best in sandy alluvial soil but nowhere attains the dimensions which it reaches in some other parts of India. It is one of the trees favoured for matches at Kota in Bilaspur.

Fl. *Jany.—March.* Fr. *March—May.*

XI.—STERCULIACEÆ.

Sterculia urens, *Roxb.* Kudlu, *Mar.* Kurlu. *Chh*; Karu, *H.*; Tabai marra, *Gondi* (S. Ch. W. P.); Tabsu, *Tel.* (S Ch. W. P.) Kasai (N. Ch. W. P.)

A large tree with white papery bark, large palmately lobed leaves and panicles of greenish flowers (while leafless).

Follicles pungent with bristles

Common on rocky hills.

Fls. *Dec.—Feby.* Fr. *April.*

Yields a gum and fibre. Planks are sometimes cut from it.

Sterculia villosa, *Roxb.* Buti (N. Ch. W. P.), Udal, *H.*

A large tree with light grey not papery bark, large palmately lobed leaves of which the lobes are often 3-partite.

Fls. yellowish and pink.

Raipur; Bil.

In valleys, not common. Planks sometimes cut from it. Bark yields a strong fibre.

Sterculia colorata, *Roxb.* Kanhakum, *Tel.*

A large or m. s. tree very beautiful in flower with its scarlet inflorescence. L. usually only 3-lobed in the adult (often more in seedlings) with only scattered stellate hairs,

Hillsides and well drained valleys.

Rai. (Salebhat); Dhiri-Mangli, Baihar and Raigarh, (Bal.) on the ghats; Machlighatta (S. Ch.)

Fl. *April.* Fr. *May.*

Deciduous *Feby.—May.*

Helicteres Isora, *L.* Marorphal, *H.*; Athai, *Mar.*; Muradphali (Bhan.); Nuldanti, *Tel.* (S. Ch. W. P.)

A large shrub with oblique pubescent 5—7 nerved leaves and scarlet lateral zygomorphic flowers. Fruit woody of 5 spirally rolled carpels on a long gynophore.

Common chiefly in rocky places on the cool slopes of hills, but also elsewhere. Fls. *April—Dec.* Fr. *Oct.—Jany.*

Mr. Cole states that the fruits pounded and fried in ghee, and sweetened, are used for colic and diarrhœa. As this is also the case in Chota Nagpur, they would appear to have some virtue.

Pterospermum acerifolium, *Willd.* Muchkand, *H.*

A handsome tree with palmately nerved cordate-based leaves white tomentose beneath and large white flowers.

Only near villages and often planted in gardens.

Eriolæna Hookeriana, *W. & A.* Bhoti, *H.*; Bhondia Dhaman, *Mar.*; Kunjai, *Gond.* (Bal.); Nar botku, *Tel.* (S. Ch. W. P.); Kutki, *Gondi* (Bal. W. P.) (N. Ch. W. P.). Sometimes called Bhoti Dhaman.

Shrub or small tree with broadly cordate coarsely toothed 7—9 nerved leaves white tomentose beneath. Yellow Fls. $1\frac{1}{2}$ to 2" diam. and ovoid tubercled capsules.

Fl. *April—June.* Fr. *Nov.—Jany.*

Wood is strong.

Melochia corchorifolia, *L.* Methuri, *Vern.*, Graham.

An undershrub with serrate plaited leaves and small white or pink flowers collected in dense heads. Common.

Fl.and Fr.r. s.

LIST OF TREES, SHRUBS AND ECONOMIC HERBS OF THE SOUTHERN CIRCLE OF THE CENTRAL PROVINCES.

The following Addenda and Corrigenda should be made to the List published in the *Indian Forester* of October 1912:—

1. **Pavonia zeylanica,** *Cav.* For the description of this plant substitute—

Pavonia odorata, *Willd.*

An erect suffruticose herb, 2—3 ft. high, glandular pubescent all over with simple slightly lobed leaves ·5—2″ long rounded to ovate-lanceclate. Fls. pink. Carpels hairy. The 10—12 linear hairy bracteoles ·4″ long are characteristic.

Fls. r.s. Fr. *Nov.—Dec.* South Chanda.

Pavonia zeylanica, *Cav.*, is very similar, but the leaves are more deeply lobed and the carpels slightly winged.

Sironcha (S. Ch.)

(*Note.*—The description of **P. zeylanica** in *Indian Forester*, October 1912, was taken from another species).

2. After **Abutilon graveolens** insert—

Hibiscus hirtus, *L.* Chendro, *H.*

An undershrub with herbaceous branches, ovate strongly serrate leaves 1—3″ often with a gland on the midrib beneath and pretty red or white flowers 1″ diameter with spreading corolla and 5—7 subulate bracteoles. Peduncles and calyx with strong hairs and leaves stellately hairy beneath. Capsule globose.

Fls. *August.*

Ghot Range (S. Chanda).

3. After **Hibiscus panduraeformis,** *Burm.* insert—

Hibiscus vitifolius, *L. Var.*

A sub-herbaceous undershrub 3—4 ft. high with shortly pubescent stems. Lower leaves 4—5″ diameter with 3 large acuminate lobes and rounded cordate base, upper lanceolate, all

more or less dentate, pubescent and with long stellate hairs. Flowers large yellow, with purple center, axillary and sub-racemose Bracteoles 8—12 linear. Calyx large with broadly lanceolate sepals.

Easily distinguished in fruit by the winged reticulately-veined carpels which resemble those of a Pavonia (but the capsule is loculicidal).

Fls. r. s. Fr. *December*.

Bilaspur.

Differs from typical *vitifolius* in the large and much less tomentose or villous leaves. In the latter respect it resembles some cingalese specimens.

4. For the description of **Hibiscus cannabinus,** *L.*, read :—

Hibiscus cannabinus, *L.* Ambari, *Mar.*

A very variable suffruticose herb 2·5—5 ft., the stem usually with scattered small prickles, leaves from large entire and cordate to palmatifid, the uppermost often simple lanceolate and curved on long slender petioles, serrate. Flowers over 2″ diameter white or pale yellow with purple eye axillary sub-sessile. Calyx campanulate with long acuminate sepals, 5 large glands, appressed white tomentum and tubercled hairs. Epicalyx with acuminate lobes.

Fls. *Oct.—Dec.* Fr. *Nov.—Jany.*

Very common. Planted on the rice bunds in rice districts and between other crops in Jowar districts. Widely cultivated for its fibre. A native of Africa, often found as an escape. Seeds used for bread, and fruit eaten by cattle.

5. After **Hibiscus ficulnens,** *L.*, insert—

Hibiscus tetraphyllus, *Roxb.*

Suffruticose herb about 3 ft. high with sparse hispid hairs on branches and 3-forked ones on the leaves. Radical leaves attain 8″ diam., cauline 3—4″, deeply or very shallowly lobed, in the deeply lobed leaves the lobes are sometimes again lobed, always

coarsely dentate or cuneate-dentate. Fls. primrose-yellow 2·5—3″ diam., axillary and racemed. Bracteoles persistent on the young fruit 4—5 ovate-lanceolate. Capsule oblong 1·25—1·5″ beaked covered with glandular and pungent hairs.

Fls. *Sep.—Oct.* Fr. *Nov.*

Bori Majra (Nag.) and probably in all divisions.

(The Nagpur plant is much more sparsely hairy than the type.)

Waltheria indica, *L.* Halduli, *Mar.*

A hoary tomentose undershrub 2—5 ft. high with velvety ovate or ovate oblong sub-plicate leaves rarely 3" long and small yellow or pink flowers in capitate cymes.

Exceedingly common on the open quartzite and sandstone plateaux of Raipur and (Sonakhan Range) Bilaspur where it forms a gregarious undergrowth. Frequent also in other divisions in open dry jungles. Fl. r. s. and c. s.

Buettneria herbacea, *Roxb.*

A branched herb with woody rootstock and curious small purple flowers, remarkable for the long slender tips and 2-fid appendages of the petals.

Common in rocky forests.

(*To be continued.*)

BURMESE *KAING* GRASS.

While at the Allahabad Exhibition, Mr. Raitt received specimens of a grass from Burma which was called *Kaing* and which promised to be an excellent material for the manufacture of paper-pulp. The correct identification of the species being, therefore, of some importance, the writer in October last asked Mr. J. H. Lace, Chief Conservator of Forests, Burma, if he could kindly have some specimens of *Kaing* sent to Dehra for identification. In response to this request a number of specimens have been received which show that all the species given below are called *Kaing* in Burma and it is possible that further inquiry will increase this list—

(1) *Saccharum spontaneum*, Linn., *Sit Kaing* (Shwegyin, Toungoo), *Bok Kaing* (Shwegyin), *Kaing Pwa*, *Kaing Ni* (Toungoo), *Kyanseingale Kaing* (Katha). *

* This is a very variable species both in India and Burma, but the various forms do not at present appear sufficiently constant to merit separate names and definitions. The principal forms are however in cultivation at Dehra and will be further studied.

(2) *Saccharum arundinaceum*, Retz., *Phaung Kaing* (Shwegyin), *Paung Kaing* (Toungoo and Katha).

(3) *Saccharum Narenga*, Wall., *Thetkkagyi Kaing* (Katha).

(4) *Saccharum fuscum*, Roxb., *Manaw-kun Kaing* (Rangoon), *Yin Kaing* (Shwegyin), *Thin kyan kaing* (Toungoo), flowers in December (Rangoon).

(5) *Arundo Donax*, Linn., *Alokyu Kaing* (Katha).

(6) *Phragmites Karka*, Trin., *Kyu-wa Kaing* (Shwegyin), *Kyu-kaing* (Toungoo and Katha).

(7) *Anthistiria gigantea*, Cav., sub-sp. *intermedia*, Hackel, *Kaing-deobok* (Katha District, 800'). Mr. Lace has recently sent specimens of two more forms of this species, *viz.*, sub-species *arundinacea*, Hackel, and sub-species *caudata*, Hackel, both collected on the Maymyo plateau, 3,500', but no vernacular names are given.

(8) *Andropogon Nardus* (forma *normalis* F. B. I.), *Kaing pyumi* (Katha).

(9) *Andropogon intermedius*, Br., *Kaing* (Rangoon).

(10) *Rottboellia Zea*, Clarke, *Pyaung Kaing*, *Kaing pabya* (Katha).

(11) *Rottboellia striata*, Nees, *Pyaungsa-gyi Kaing* (Katha).

(12) *Coix Lachryma-Jobi*, Linn., *Gyeik Kaing* (Shwegyin and Toungoo) *Kyeik Kaing* (Katha).

(13) *Triraphis* (*Neyraudia* F. B. I.) *madagascariensis* var. *Zollingeri*, Hook f., *Nat-mya Kaing* (Rangoon), *kyunabin Kaing* (Toungoo), flowers in December (Rangoon).

(14) *Polytoca Wallichiana*, Benth, *Na-yar kaing* (Shwegyin).

(15) *Thysanolaena Agrostis*, Nees, *Thamasine Kaing* (Toungoo).

It is thus clear that Kaing is a general term applied in Burma to all large grasses growing in savannahs and swamps, the different species being as a rule distinguished by some descriptive epithet such as *Sit Kaing*, *Phaung Kaing*, and so on.

This interesting point could not have been settled without the kind assistance of Mr. Lace to whose magnificent collections

and unfailing interest in botanical questions the Forest Department, generally, and the Forest Research Institute, in particular, owe a heavy debt of gratitude.

As regards the value for paper-pulp of the species mentioned above, it must be noted that only a limited number of samples could be dealt with by Mr. Raitt owing to the short time at his disposal. In selecting the samples for Mr. Raitt, also, it was necessary to pay special attention to those species which were likely to be of most value on account of their wide distribution and frequent dominance over large areas, not only in Burma, but also in India. The species numbered (1) to (9) inclusive and (13) in the above list are, however, being examined by Mr. Raitt and his report dealing with them is expected to issue within the next 12 months.

It is hoped that Forest Officers in Burma will continue to take an interest in their forest grasses and to send specimens thereof to Dehra Dun for identification, so that more complete information may be obtained regarding the distribution of the various species, their vernacular names, time of flowering, habit, characteristic habitats, economic uses, whether they tend to occur practically pure or in admixture with other species and other points. The vernacular names given in the above list should be checked by further inquiries, and it would be of great interest if the English equivalents of the Burmese epithets could be supplied in each case. It is particularly desired that attention be concentrated on those species which are likely to be of most value, *i.e.*, those—

(1) which are known to be of considerable economic value ;
(2) which tend to occur more or less dominant over large areas and to give a character to the vegetation ;
(3) which tend to occur constantly in mixture with grasses of class (1) and (2) and in considerable quantity ;
(4) which are likely to be confused with valuable species when collected for paper-pulp or other purposes.

R. S. HOLE,
Forest Botanist.

FIRE-PROTECTION AND ITS RESULTS IN THE GODHRA RANGE, PANCHMAHALS.

In the issue of this magazine for October 1906, I tried to show the far-reaching havoc caused by the drought of 1899-1900 in the forests of the Godhra Range and in the January number 1908, I tried to show the effect of the drought on the regeneration in the same forests. I shall now try to give a brief description of the effect of fire-protection in the same forests.

In January 1908 I stated that an extensive part of these forests was annually burnt. This occurred till 1902 when specially protected areas, well fire traced and divided into sufficiently small fire compartments, provided with fire watchers, were introduced; even these were not immune to fire till 1906, the energy of the whole staff being engaged in extracting the dead and dying teak during that period. From 1906 strenuous efforts were made to combat the fires, and to achieve this object neighbouring villagers have from time to time had their privileges suspended and in the worst cases double grazing fees were imposed upon them. These, restrictions sometimes told rather harshly on them, and were at all times felt by them as hardships; but subsequently they got accustomed to them and the result is that the fires in the specially protected areas showed a decrease of from 19·04 to 5·7 per cent and in the remaining forests, protected solely by the guards without having any fire-protective operations introduced in them, from 31·08 per cent to 12·3 per cent. The result has been that in those portions of specially protected areas and in other areas saved from fire continuously for the last 10 years a great improvement in the natural regeneration of the forest is apparent, while the quality of the grass has also improved. Fire-protection has increased the fertility of the soil by adding to it the organic manure, which is a necessary nourishment for the tree growth as soon as the seeds germinate and their roots penetrate into the soil. The seedlings of teak, *Tectona grandis*; Khair, *Acacia Catechu*; Bia, *Pterocarpus Marsupium*; Royan, *Soymida febrifuga*; Dharida, *Anogeissus latifolia*; Mokha, *Schrebera swietenioides*; are found in numbers in the portions protected from fire. In the northern portion of

these forests the grass is very high and dense, and the seeds find some difficulty in reaching the ground, but there too they have made their way somehow or other, and the seedlings of various species are found though not so numerous as in other places. They are doing good to the forests in converting pure teak into a mixed forest. This is not the only advantage the forests have gained by continued fire-protection, changes in the growth of grasses are also noticed in various places. The grasses at present prevalent are—(1) Karedi, *Apluda varia*; (2) Sunkhli, *Andropogon contortus*; (3) Karvat, *Andropogon foveolatus*; (4) Jinjwa, *Andropogon annulatus*; (5) Bhusi, *Eragrostis tenella*; (6) Bhathi, *Anthistiria cilata*; (7) Gandheli, *Iseilema Wightii*; (8) Khavo; (9) Dab.* Out of these Jinjwa, Gandheli, Bhathi and Khavo are considered good fodder grasses and the rest bad except Sunkhli which when young is relished by cattle. The constant burning of the forests in former years had allowed the coarser grasses like Karedi, Sunkhli and Dab to usurp the place of finer ones, but since the introduction of fire protection the coarser grasses are in most places dying out and are being replaced by the finer ones like Jinjwa, Gandheli and Khavo. Even Bhusi which is a very short grass growing on very poor soil and which prevents the germination of any seed except Royan, is found in most places displaced by Jinjwa and Gandheli in bunches under whose shade are now found seedlings growing up where there were none before. The people of the surrounding villages have also now begun to understand that the best fodder grasses are now replacing coarser ones on account of the keeping out of fires from the forests; and it is therefore hoped that the internal fires in these forests will be stopped altogether in a few years, though the fires entering the forests from outside the boundary, which is surrounded by the forests of Native States, will be difficult to stop until some settlement is arrived at with the chiefs of those States.

AMABALAL K. DEAR,
Ranger, B. P.

* Probably *Eragrostis cynosuroides*.—(Hon. Ed.)

MESSRS. BECKER GRAY & CO.'S LAC FACTORY AT CHAMPA IN BILASPUR DISTRICT, C. P.

This lac factory is situated on the banks of the Hasdo river near Champa Railway Station. It is quite a new enterprise and in fact had only been working for a few days before Mr. Campbell, the manager, very kindly showed me over the factory and explained the processes to me.

Messrs. Becker Gray & Co. have, I understand, started the factory for the conversion of stick lac into button or shell lac in this lac growing centre and market with the object of reducing middleman's charges and saving freight on the carriage to Europe. Most of the lac received in the factory is still on the stick and has not been scraped off as one so often sees done in the forest. The first process of the factory therefore is to separate the pure lac from the wood and other refuse. To do this the lac is first crushed in a grinding machine and then passed through a sieve. This gets rid of the larger pieces of the wood and dirt. After this the lac is winnowed and then soaked in large stone vats. Great trouble is taken in the factory to remove all traces of colouring matter from the lac before manufacturing the shell lac. Most of the coloured lac is in the form of round hollow bubbles from which the insect had not swarmed before the collection of the crop. This lac floats while ordinary solid lac does not. In making the raw material therefore in the large stone vats the coloured lac with any sticks left in it floats on the surface of the vats. It is thus collected, separated from the dirt, crushed and thoroughly washed. This process removes most of the colour but to complete the removal of all traces of colouring matter, the lac is finally treated with Fuller's earth and then dried to be ready for conversion into shell lac.

I was particularly struck with the great care that is taken in the factory to remove all colouring matter. The quality of shell or button lac is judged in the market by its transparency and absence of colouring matter. Another point which struck me very much was the enormous trouble that is taken to prevent any form of waste. The factory is made to drain from all points in

which water is used to a tank in which the red coloured washings are collected and any lac which finds its way into it is extracted. This water is of a deep red colour and is drained off into pits outside the factory. When the pits are dried up lac is extracted by a steaming process from the cake formed in the bottom. Even the sand and earth on the floor of the factory is scrupulously treasured up with a view to the extraction of any lac that may be found in it.

After all waste material has been thoroughly treated to make sure that no lac has been overlooked, the cleaned lac is dried in a large cement floored quadrangle made for the purpose. After the drying it is placed in cylindrical sausage-shaped cloth bags of a length up to about fifteen or twenty feet. It is then ready to be melted.

In melting large half open charcoal retorts are utilised. The long sausage-shaped bags of lac are held at one end by a man who slowly revolves the bag before the furnace, the man at the end nearest the furnace is continually busy with the lac as it exudes from the bag owing to the heat. His business is to see that the lac does not become charred or burnt and that as soon as it has the right colour it is taken off the surface of the bag and put into iron trays to cool as button lac. This is clearly the work of an experienced expert and to carry it out special men are imported from Mirzapur.

The factory manager estimated that he would be turning out forty maunds of button lac a day and to make this would require forty maunds of charcoal. If the factory is working throughout the year this would mean a market for at least 5,000 maunds of charcoal per annum; a fact worth considering, when one thinks of the wretched prices for firewood that we get in some divisions of the C. P. in coupes even near the railway.

Labour appears to be a source of some anxiety in the factory. At present everything is worked by hand and the more important operations have to be carried out by expert labour from Mirzapur which I fancy is not cheap On the other hand the Chattisgarhi

no doubt could learn the work but he is a lazy beggar and there seems little chance of his taking to it.

Mr. Campbell told me that there is some idea of taking electric power from the Hasdo river—a plan which if carried ou would reduce the labour by 66 per cent. It is hoped that this will be a success and that Messrs. Becker Gray & Co.'s enterprise will be suitably rewarded. The starting of the factory will create a better market for lac, as well as a demand for charcoal and wood for making into packing cases. I cannot conclude this note without acknowledging my great thanks to Mr. Campbell for his courtesy in letting me see the factory and taking so much trouble in explaining the processes to me.

JAMES W. BEST,
Divisional Forest Officer,
Bilaspur Division.

PROGRESS REPORT OF FOREST ADMINISTRATION IN THE MYSORE STATE FOR THE YEAR ENDING 30TH JUNE 1911.

As Mysore is one of the most progressive Native States we have read this report with some interest. The area of the State forests has increased by some 22 sq. miles while that of the reserved lands by 70 sq. miles, they now cover 840 sq. miles. This nomenclature "reserved lands" seems to be confined to Southern India, we imagine that their status is more or less that of "protected forest" and we do not see why they should not be frankly termed "protected forests."

Working-plans have not made the progress that we would have liked to see. Apparently 1,939 sq. miles out of a total area of 2,595 sq. miles of reserved forests are not as yet under systematic management. No new plans were undertaken during the year nor were any new plans sanctioned by Government, while the provisions of existing plans have not been fully carried out.

On roads an expenditure was incurred of Rs. 11,237 ; looking to the large surplus of the province and the extensive area of the

which water is used to a tank in which the red coloured washings are collected and any lac which finds its way into it is extracted. This water is of a deep red colour and is drained off into pits outside the factory. When the pits are dried up lac is extracted by a steaming process from the cake formed in the bottom. Even the sand and earth on the floor of the factory is scrupulously treasured up with a view to the extraction of any lac that may be found in it.

After all waste material has been thoroughly treated to make sure that no lac has been overlooked, the cleaned lac is dried in a large cement floored quadrangle made for the purpose. After the drying it is placed in cylindrical sausage-shaped cloth bags of a length up to about fifteen or twenty feet. It is then ready to be melted.

In melting large half open charcoal retorts are utilised. The long sausage-shaped bags of lac are held at one end by a man who slowly revolves the bag before the furnace, the man at the end nearest the furnace is continually busy with the lac as it exudes from the bag owing to the heat. His business is to see that the lac does not become charred or burnt and that as soon as it has the right colour it is taken off the surface of the bag and put into iron trays to cool as button lac. This is clearly the work of an experienced expert and to carry it out special men are imported from Mirzapur.

The factory manager estimated that he would be turning out forty maunds of button lac a day and to make this would require forty maunds of charcoal. If the factory is working throughout the year this would mean a market for at least 5,000 maunds of charcoal per annum; a fact worth considering, when one thinks of the wretched prices for firewood that we get in some divisions of the C. P. in coupes even near the railway.

Labour appears to be a source of some anxiety in the factory. At present everything is worked by hand and the more important operations have to be carried out by expert labour from Mirzapur which I fancy is not cheap On the other hand the Chattisgarhi

forests, this expenditure might well have been increased. Building operations have shown good progress, some Rs. 39,000 having been spent on them.

Forest offences are somewhat rife. The number of cases dealt with by the Magistracy was 57 of which 22 ended in convictions. 22 out of 57, however, does not make 61 per cent as stated in para. 20 of the report. 177 cases of injury to sandal trees were reported. In the Kolar Division there were 7 such cases which ended in convictions, a total of Rs. 580 in fines being imposed, of which only Rs. 18 was duly recovered ; this is rather a travesty of justice.

Fire-protection was attempted over 1,487,000 acres, of which 97,000 acres were burnt. The measure of success varied considerably in the different divisions, one division showing 99·9 per cent. and another 73·1 per cent.

Spike disease still continues with dire results. In two districts alone over 70,000 sandal trees and plants had to be uprooted.I t may be noted that the investigation of this disease is proposed to be taken up through the agency of the Forest Research Institute, though it is difficult to see how this can be efficiently undertaken until the staff of the Institute has been strengthened. However, we can only hope for the best.

Sowing and planting operations were carried out over 53,000 acres with somewhat doubtful success. It would probably be advisable to concentrate operations over smaller areas.

Passing now to the financial returns, 2,469 tons of sandal wood were sold yielding nearly 11½ lakhs of rupees. This was exclusive of chips and sawdust. The average price per ton including the two above items was Rs. 471 as against Rs. 461 in the previous decennial period.

The total revenue for the province was Rs. 20,89,000 with a surplus of Rs. 14,06,000 or more than 2 lakhs above that of the previous 10 years. With this large surplus it would seem expedient to improve the pay and prospects of members of the Department, and we will watch with interest the result of the reorganisation scheme that has been placed before the Mysore Government.

The report is lucid and interesting but it makes us feel that much more might be done and various improvements carried out if the Department were better manned. In order to allow of greater progress in working-plans, sowing, planting, etc., we cannot but think that the Darbar would be wise to divide up the province into two circles at any rate for a period of years. The charge seems too large for one Conservator, looking to the inadequacy of the staff and to the large amount of supervision and administrative work that is evidently necessary. The Mysore Government must, however, be congratulated on having retained the services of Mr. Muttanah, who, in spite of many obstacles, seems to have kept things going and to have fully worked up to the reputation which he deservedly enjoys.

WITH THE JUNIOR CLASS IN JAUNSAR.

The Forest College at Dehra Dun is lucky enough to have at no great distance an ideal retreat for the hot weather, and the two classes annually at the beginning of May spend a couple of months in the splendid Himalayan forests of Jaunsar. Going straight west from Dehra for 30 miles along the Dun we meet the Jumna close to where it is joined by the Tons river and start the long gradual ascent to Chakrata. From the tea gardens of Ambari the cart-road climbs slowly up a long bare valley for 26 miles ending at Chakrata at 7,000 feet. Chakrata and Kailana extend over some four miles along a ridge projecting south from the hills and are pleasantly wooded all round the houses and cantonments, with steep bare grassy slopes below, which, interrupted by small plateaux of wheat-fields and villages, stretch down to the distant valleys of the Jumna and the Tons. We halt here for two or three days to see the fuel depôt and cantonment forests and then start off for the first camp, a three mile march with a rise of 2,000 feet ending at Deoban, where a couple of forest bungalows with Range and Students' quarters make a little colony at 9,000 feet. From the terrace outside the bungalow a splendid view of the distant snows is usually to be had, sometimes extending as far as the peaks

of Nanda Devi and Trisoul to the east behind Naini Tal, and the cold air cools the fevered brows of some of the students from the plains who have had a good deal of the *ghi* taken out of them by the steep climb. Round the bungalow the forest consists chiefly of the dingy *Karshu* oak, wrapped in mantles of moss, but a little lower down splendid woods of spruce and silver fir begin, with scattered plantations of blue pine and deodar. From Chakrata View, just to the south of the bungalow we get a glimpse of the distant and giddy Charleville Hotel at Mussoorie, and the jagged outlines of the Siwaliks meet our view, low and continuous beyond the Dun, when not hidden by the thick hot weather haze that creeps up the valley of the Jumna. A distant mass of smoke on their slopes claims our sympathy for the Divisional Forest Officer, Dehra Dun, whose percentage of successful fire-protection of his sal forests has evidently been reduced. At Deoban we spend a week or ten days, laying out hill roads, counting sample plots of natural regeneration, learning the difference between a shade-bearer and a light-demander, and absorbing an assorted stock of sylviculture in all its branches. Nursery work is done in detail, fortunately under better conditions than last year when the snow had to be dug away before work could go on. Five hours in the forest, from seven to twelve, gives us an appetite for tiffin, and a lecture is usually given in the afternoon on the old tennis court. Our next camp is at Bodyar, some seven miles off to the west, a beautiful march through the forest along the narrow hill roads that run in all directions round the Jaunsar hills. A short descent takes us out of the oak and into a large belt of spruce and silver fir which continues almost to Bodyar where the deodar begins at about 8,000 feet and runs down through a most picturesque valley below the comfortable little three-roomed bungalow perched on the slope. This is the land of plantations alluded to in the journals belonging to the Division, and the subject of flattering and sarcastic remarks of Conservators and Inspectors-General of bygone days. The green of the scattered deodar and blue pine plantations, pure and mixed, all over the valley, contrasts with the heavier masses of spruce, silver fir, and deodar forests below the

mountain tops, and show up the bare patches on the hot southern slopes where numerous efforts have been made to sow and plant, in many cases with doubtful success. Deodar grows about one foot each year in the plantations and blue pine nearly twice as fast, and there is no lack of areas in which the students can make measurements and countings. Below the higher wooded slopes deep rocky valleys, full of maples, *Moru* oak and wild strawberries, join to form the sources of tributaries of the Tons, and in these wild and lovely spots the lucky shikari who is early enough afoot finds the black bear, the goral, or the musk-deer, or drives the pheasants across the narrow glens between the lower plantations. Of recent years the bears have developed a great liking for the inner bark of the deodar, and have done great damage by taking the whole of the bark off groups of trees three or four feet in girth in some of the older plantations, as well as in natural forest, so that the Divisional Officer is pleased to hear of their execution. At one place outside a small cave the whole of the bark up to 12 feet from the ground had been removed, and the trees will die in a year or two.

On each side of the Bodyar valley rises a hill over 9,000 feet high, Lokhandi, with dense silver fir on its slopes, and Moila, with a considerable area of grassy downs where the Jaunsari shepherds bring their flocks of goats and sheep. In the hollows are built stone altars of the family bible pattern on which fires are lit at night to scare away cockatrices, and the flocks are further guarded by numerous savage dogs which wear broad iron spiked collars to protect them from panthers. The shepherds are quaint uncouth beings who seem to camp cheerfully among their animals whatever the weather, and are continually calling and whistling to them as they stray along the higher slopes under the spruce trees where the forests are usually open to grazing. A halting conversation which I carried on with a shepherd in a mixture of Burmese and Jaunsari Hindustani was further complicated by the curious habit which he seemed to have acquired of giving a little whistle between every two or three words.

Konain and Mundali, the other two places at which the Junior Class camps, are situated amid older forest and are both very

picturesque. Steep hills rise on at least one side and very fine old deodar, spruce and silver fir forest cover most of the steep slopes. A good deal of deodar is being felled and sawn on the spot into sleepers which are carried down the hills by precipitous paths by coolies to the nearest floating stream, down which they float to the Tons during the rains. After the rains they are floated down the Tons to the boom near Kalsi where they are caught and rafted to the railway. Contractors pay fifty or sixty rupees per tree and felling is done for them in the best deodar forests by Government as their own men fell so carelessly that many young trees are destroyed. Few of the tramways, sledge-roads, and slides formerly used in Jaunsar are now to be found as extraction is done by the contractors, but a tramway and a fuel shoot are used to bring in fuel to Chakrata.

The story of the end of the Thadiar wet slide is thus told by Mr. Gleadow in his account of the school tours in Jaunsar in 1898 and 1899 :—

" At 6 P.M. on the 8th August 1889 a furious storm broke over the Deota ridge, 6 inches of rain being registered in a few hours. About 10 P.M. a tremendous flow of water, mud, and débris of all kinds reached the head of the slide, the water, from the marks left on the banks, having been about 40 feet deep. This flood swept down the valley in a series of rushes caused by the temporary damming up of the ravines at narrow places, and in the course of a couple of hours it completely wrecked and carried into the Tons river nearly the whole of the timber slide, notwithstanding the fact that it was in some places situated 50 feet above the stream. The catastrophe was unfortunately accompanied by the death of 12 chowkidars who were asleep in a cave near the head of the slide, 20 feet above the stream. Their bodies were never recovered, having been apparently ground to paste in the mud and boulders. The transporting power of the torrent was enormous, large boulders weighing from 20 to 100 tons having been carried along for hundreds of yards, by means of the mud, which being afterwards washed away, these boulders may now be found deposited high and dry along the bed of the Thadiar Khud. About 36,000 sleepers were

also washed into the Tons river from Thadiar depôt. Of these about 10,000 were never seen again and the total loss caused by the flood amounted to about Rs. 40,000 together with the 12 lives referred to."

In the hot weather and at the beginning of the rains the flowers in the hills are in many places a continually changing delight. Anemones, *Aquilegia*, *Delphinium*, *Morina*, ground orchids, lilies, and many less conspicuous flowers cover the ground in great patches while the flowering shrubs, Clematis, *Schizandra*, *Indigofera* and the two species of *Deutzia* provide beautiful masses of colour beside the dark conifers. In June the ground in places is covered with the flowers of the snakeplant, an aroid with a overhanging cobra-like spathe, and in the valleys the bushes of *Cornus capitata* are covered with flower and can be seen for miles. In the Jaunsar ointment there are however several flies. One is the small *Potu*, the blister-fly, and another is the Jaunsari himself who appears to be an uncouth and conservative being, given to little work and less washing and to living as far as possible on the labour of his hereditary slaves, if fortunate enough to possess any. We had little to do with the villagers beyond turning them out in hundreds to carry our kit from one camp to another and this work they performed at an incredibly slow pace.

Another fly in the ointment is reported by Assistant Conservators to be the necessity of climbing almost perpendicular cliffs of great height to mark deodar for felling.

Some of the picturesque aspects of Jaunsar are fully appreciated by the students, as shown in the following extracts from their journals:—

"I happened to see two herds of sheep grazing on the hills. No one can feel the greatness of the day except myself who saw these poor and timid creatures going up and down the slopes......

Our Instructor was then kind enough to dismiss us and what to speak of our joy—we ran as soon as our legs could carry us and having appeased appetite in the city, proceeded to the camp......

After meditating a while over this blank in the forest, we proceeded to Snow View and admired the picturesque view administered by the surrounding hills..............

Yellow and white flowers were blooming over the green velvet spread by the nature. How interesting it was for me to see the lonely sheep bleating in the meadows..............

Contractors are generally Bunyas who earn a lump sum money of profit.........The town of Kalsi is really beautiful and charming and boasts of having a post-office, school and police-station, which are with one temple, the only beautiful and splendid buildings. The street is composed of a few wretched shops, the surroundings of which are dirty and filthy.............. Attention must be paid to the little seedlings until they catch hold of the existence......... The view at Konain is very beautiful and picturesque. The weather is an enjoyable one. The cool breeze refreshes the mind. Near the camping ground is a potato field in which the dirty people are engaged in weeding the potatoes."

FLOATING FACTORIES FOR WATERWAYS.

There are certain forest products which exist in large quantities in India but which are rarely amenable to industrial treatment because they are inaccessible. Their inaccessibility arises in some cases from mere remoteness from marts and industrial centres. Even where they are found in large quantities, there are often no adequate communications, or the distances are so great that heavy transportation charges would be incurred in bringing them to market. In other cases, the difficulty arises from the circumstance of their being found at any one place in quantities too small to recoup either the cost of collection or the cost of erecting at a fixed point any appliances for their primary treatment or manufacture. The bad surface of the ordinary country road in India adds greatly to the labour of bringing in bulky raw materials that contain a large proportion of waste ; and, when such roads have been rendered soft by rains, the difficulty is enhanced.

Timber, tanning materials and waste wood for distillation are examples of such products ; and, where roads alone are to be relied upon, it is often impossible to make any use of the large supplies. But in parts of India—as for instance in Lower Burma —there are long stretches of waterways which are not only easily navigable but which bear upon their banks large quantities of valuable raw materials. It is probable that at some points these exist in quantities sufficient to warrant the erection of plant on a large scale. But such a venture involves many considerations besides that of the raw material. These fall under such heads as fuel, water, labour, stores, repairs, freedom from surface water in rains, and so on. Even under favourable conditions, it is a feature of such enterprises that, as adjacent supplies are exhausted, the manufacturer has to go further afield with the possibility that he may ultimately have to dismantle his factory and move it to another point. These risks are often sufficient to deter the capitalist from such a scheme ; but it seems quite possible that the existence of waterways navigable by craft of considerable size may be found to offer a solution of the difficulty. Not only might the comparative cheapness and constancy of water carriage enable a

manufacturer to bring his raw material to a large factory at a fixed point, but it is quite conceivable that such industries as can be efficiently conducted on a relatively small scale might be carried on by means of machinery installed in one of the commodious flats or barges that are used in those waters. Such a floating installation could move freely about the creeks of Lower Burma, for example, could come into operation where supplies of raw material existed, and could proceed periodically to Rangoon for overhaul.

One of the most familiar types of flat in the creeks of Burma has a length of 200 feet, a beam of 27 feet and a depth of 8 feet 6 inches. This type of flat has a draft, when empty, of 1 foot $6\frac{1}{2}$ inches, lifts $11\frac{1}{4}$ tons per inch immersion and carries, at a laden draft of 5 feet, about 467 tons.

It will be seen that such a flat could carry a considerable weight of machinery and materials. The finished product would no doubt be sent forward by the steamers which traverse the waterways daily.

One of the simplest applications of the proposal would take the form of a floating sawmill. It is understood that certain useful timbers such as *sundri* (Heritiera fomes) exist in considerable quantities in the creeks but are shut out from use by two conditions. The first is that they are too heavy to be floated by themselves, and the second is that, whether in a raft or in the hold of steamer or flat, the log in the round takes up a great deal of room. It is believed that such timber, if squared at its place of origin, would lend itself to transportation in hold, and would become the subject of a remunerative trade. For woods like *sundri* are in good demand. Experts assert that no great mechanical difficulty is presented by the installation in a flat of such a saw-bench as would suffice for the squaring of timber for transport, and that the engine for sawing could also operate a wire hauling tackle for extracting the timber and even a propeller for moving the flat from place to place at an adequate speed. Having regard to the flow of the tides in the Burma creeks, it is believed that a speed of six to seven miles an hour would be sufficient for this purpose.

A mechanical engineer in London has been in correspondence with the Director-General of Commercial Intelligence with regard to the equipment of such a floating sawmill, and has now brought the study to a point at which he is able to specify and quote for a complete plant installed on a suitable barge or flat which might, if desired, be self-propelling. The name and address of the engineer in question may be obtained on application at the office of the Director-General of Commercial Intelligence, 1, Council House Street, Calcutta.

Another industry in which a floating installation might perhaps be employed with advantage is the manufacture of tannin extracts. Crude tanning materials contain only a small proportion of tannin, and freight has to be paid on the greatly preponderating mass of waste material contained in them. In the vicinity of some large tanneries in India, the country has been denuded of tanning materials and the increasing transport charges impose a very serious burden on the industry. India also exports large quantities of crude tanning material; but the rise in sea-freights is restricting this branch of business, and tanneries in Europe resort increasingly to the use of concentrated extracts made where the raw material is produced. The mangrove grows luxuriantly about the creeks in Lower Burma, and there is no very evident reason why it should not be possible to conduct the manufacture of the appropriate extracts by means of a floating plant which could move from place to place as supplies were exhausted. It is, of course, necessary to bear in mind the considerable weight of the vats when full of liquor; and it is possible that such brackishness as is present in the water of some of the creeks might injure the evaporating plant. These points call for expert examination and it is hoped that competent engineers and chemists will interest themselves in the project. The Director-General of Commercial Intelligence will furnish the fullest available information as to the facts involved.

The designing of a floating plant for the destructive distillation of wood presents difficulties peculiar to itself. An article on the subject of the openings for such an industry in India appeared in our issue of 29th February 1912 (page 290).

Proposals have also been mooted for the installation of a baling press for jute upon a flat that could move about the waterways of Bengal; but it is understood that in this matter the mechanical difficulties arising from the need for a horizontal press are secondary to the reluctance of businessmen to accept pressed bales about the nature of whose content they have had no opportunity of satisfying themselves.—[*The Indian Trades Journal.*]

ELECTRICAL WOOD-SEASONING.

A novel electrical method of treating timber is said to have given striking results in France, and to have changed the greenest wood into perfectly seasoned material. A water-tight tank of suitable size is required. The timber is piled on a large lead plate at the bottom until the tank is full, when a second lead plate is placed on top of the pile and connected to the negative pole of a dynamo, the bottom plate being connected to the positive pole. The space around the timber is then filled with a solution containing 5 per cent of resin, 10 per cent of borax, and a trace of carbonate of soda. On turning on the current, it passes from plate to plate through the wood, driving out the sap, and the resin and borax takes its place in the cells and interstices. This process being completed, the timber is taken out and dried when it is ready for use.—[*Capital.*]

WHITE-ANTS.

The damage done by white-ants in India yearly is said to run into untold lakhs of rupees. The bulk of this damage is done under ground to growing crops, and no way has yet been found of successfully coping with it; though something can be done to prevent timber, railway sleepers and so on from being destroyed. It is, therefore, instructive to see that experiments recently carried out in Australia go to show that white-ants may be driven away by the use of German potash (kainit). In the antipodes the ubiquitous white-ant has developed a special weakness for fruit trees.

and the Australians have ascertained that if three to four pounds of kainit per large tree are mixed with the soil and spread about the roots, the ant promptly leaves that tree in search of a more nviting locality. A powerful factor in connection with this treatment is that kainit is not only useful in warding off attacks of white-ants, but is a valuable manure in addition ; so, by using it, farmers and orchardists kill two birds with one stone. As we have said, the white-ant admittedly holds sway in the agricultural tracts of India, and it is to be hoped that kainit has come at last to dethrone it.—[*Capital.*]

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EXTENSION OF FORESTRY IN THE UNITED PROVINCES.

RESOLUTION.

Forest Department.

Dated Naini Tal, the 26th August 1912.

OBSERVATIONS.—The attention of the Lieutenant-Governor has for some time been directed to the importance for the future development of the province of a defined policy in the matter of the preservation of the wooded areas now in existence, the *reboisement* of areas which have been denuded of their trees and the establishment throughout the province of well-distributed fuel and fodder reserves.

2. The important bearing of afforestation on the economic problems of the country is not a recent discovery. The first impulse came from Sir Dietrich Brandis, who in 1873 was already advocating the establishment of the "agricultural forest" and had initiated steps towards the realization of this policy in Ajmer-Merwara. And at the close of his official career it was on his

advice that the Madras Government associated the Forest Department so closely with the development of agriculture. The importance of the question was recognised in the report of the Famine Commissioners of 1880 and in the resolution of the Government of India of March 1883 dealing with that report, which called attention to the rapid diminution of grazing lands and wooded tracts in the United Provinces and to the damage resulting from indiscriminate grazing. It was pointed out that thousands of cattle had been saved by the protected grazing of Banda and that thousands had perished in Jhansi for lack of such protection. Inquiries were suggested as to the practicability of the formation of fodder and fuel reserves. It was ascertained that *usar* land was available in abundance and ravine land in considerable quantities. An outcome of these investigations was the ravine experiments in Etawah and Jhansi and the establishment of canal plantations at Cawnpore, Agra, Roorkee and other places in the province. In Madras the fact that the State is the owner of waste land and that, owing to the physical character of the country, cultivated land and forest are brought into more constant and intimate contact, rendered the policy of summoning forestry to the aid of agriculture easier of realisation.

3. But the value of afforestation as providing fuel and forest reserves found its clearest and most forcible exposition in the treatise of Dr. Voelcker, the Agricultural Chemist, deputed in 1890 by the Royal Agricultural Society to report on the possibilities of improvement in Indian agriculture. The formation of fuel and fodder reserves is advocated by Dr Voelcker as by far the most important of all his recommendations. In one passage he speaks of this as the "one practical measure which calls for the most urgent attention and from which the greatest benefits may be expected to follow." His other recommendations and suggestions he considered of secondary importance compared with this. He pointed out that the two great needs of the cultivator are water and manure. His inquiries showed that the good cultivator will never burn his manure when he can get wood. The export of both crops and manure must tend to the eventual

deterioration of the land. The first result of famine is the depletion of the cattle and the further diminution of the manure available. Manure is as essential as water as a safeguard against famine. It ought to be possible by the provision of fuel and fodder reserves to restore the manure to the land and by a resultant increase in cattle food to augment the number of cattle, setting free still further supplies of manure—an endless chain of benefaction. Such a policy would further tend to check the rising cost of cattle power, a factor which at present bids fair to profoundly modify the conditions of agricultural development.

4. These principles are in their generalised and abstract form indisputable : it is in their application to practice that difficulties arise. Obstacles to the prosecution of a policy of creating fuel and fodder reserves present themselves in connection with acquisition of land and the disinclination of the landholder or the tenant to realise the benefit of postponing his immediate advantage to the interest of his posterity. There is a danger that the constitution of forest reserves may involve the harbouring and multiplication of wild animals which ravage surrounding cultivation and a further obstacle has presented itself in the necessity for replacing the grazing areas curtailed during the establishment of such afforested areas. Such restriction is liable, unless alternative grazing areas are made available, to react unfavourably on cattle-breeding. Inquiries tended to show that while the cultivator will burn wood in preference to manure so long as free wood is available, it is very doubtful if he will do so when the use of wood means an appreciable sacrifice in money. While admitting the existence of a host of practical difficulties to be encountered in carrying into effect a general scheme of *reboisement*, the Lieutenant-Governor remains unconvinced that these difficulties are insurmountable, or that they should deter the Government from attacking the problem or from making a survey of the possibilities of an advance along the lines of least resistance. There are many areas of waste land in the province where the establishment of forest cannot affect the interests of high farming or cattle-breeding, and where the main result of such establishment would be to

transform tracts which are barren and useless into productive and protective ones.

5. Apart from the direct benefits conferred by wooded areas in the provision of fodder and fuel, their general effects on the countryside cannot be ignored. Although data are not yet available in India whence it can be demonstrated that forests increase the total rainfall, it would appear probable from the investigations undertaken in those countries where the effects of forests have long been observed that they do so operate. It is beyond question that by the diffusion of cooled air they induce a more evenly distributed and extended precipitation and mitigate the severity of the climate. Their influence on the water-supply of a tract is equally important. The forests regulate the water in the soil and the moisture in the air by retarding evaporation and by retaining rain in the vegetation and sub-soil to find its way without erosion into the nearest stream. They accordingly improve the irrigation of a tract by causing an equable flow in rivers and water-courses and by preventing floods which may devastate cultivation and which rob the country of valuable soil.

6. There are undoubtedly considerable expanses of the land now yielding a bare sustenance to a few cattle which might be transformed into valuable reserves: and it would perhaps not stretch the imagination unduly to conceive a future in which enlightened local bodies should undertake the establishment of such plantations and from them derive and diffuse much benefit. There are in Europe towns and villages which not only draw from their communal forests a revenue sufficient to cover all rates and taxes but obtain a surplus for division among their inhabitants. It is not impossible that afforestation may prove the most practicable method of restoring fertility to an exhausted soil, and that the agricultural future of the plains may lie in their approach to an ultimate ideal of the rotation of forest and cultivation.

7. Tree plantations may often have a direct commercial value distinct from the normal income accruing from the sale of wood and fodder. The Fisher forest at Etawah is an instance in point, and forms an excellent example of the successful and profitable

conversion of barren ravine land into a plantation, valuable alike to its owners and to the town it adjoins. In 1884 Mr. Fisher, then Collector of Etawah, arranged with nineteen zamindars for the reclamation as a fuel and fodder reserve of a tract of nearly 3,000 acres close to the town ; of this tract six-sevenths consisted of barren waste largely intersected by ravines. The proprietors were to provide funds for enclosure, the management was to remain in the hands of the Collector and the profits accruing from the sale of grass and fuel were to be distributed *pro rata* among the co-sharers. Grazing was to be excluded, trees, and in particular the babul, to be sown and embankments to be thrown across the ravines. The cost of fencing plantation and sowing was about Rs. 1,100 and was paid by the zamindars. The Collector spent Rs. 675 in raising embankments. Up to the year 1892 the average annual income from the plantation was Rs. 650. By that year all expenses had been paid off and the zamindars had received Rs. 275 in profits. The timber was then though very young already worth more than Rs. 1,000 and the lease for the cutting of grass and collection of dry wood sold for Rs. 900 yearly. It had not then become possible to allow grazing. In 1902 the zamindars, with the Collector's consent, leased the forest to Messrs. Cooper, Allen and Co. for fifty years at a yearly rental of Rs. 1,416 and a cash payment for fixtures of Rs. 5,000. Under the terms of the lease a third of the area was to remain open for grazing. This instructive and successful experiment thus passed out of the hands of the local authorities and landholders, who have no longer a direct interest in its success. It has since been exploited by Messrs. Cooper, Allen and Co. for the extraction of babul bark for tanning purposes. It still, however, provides grazing and cheap fuel to the town of Etawah and is said to have mitigated the severity of its climate.

8. With a similarly dual object, agricultural and economical, the Lieutenant-Governor has recently devoted Rs. 70,000 to the acquisition of babul-growing areas in the Hamirpur district. These plantations are intended, on the one hand, to preserve and make available to the tanning industry, the supplies of babul bark essential to its existence and incidentally to derive from that industry

an adequate income, and on the other hand to serve the interests of the land itself by preventing denudation and erosion, by arresting the cutting-back of ravines and by providing reserves of fodder and fuel. There is so much good land for babul plantations in the Hamirpur district outside the ravine area that it has been determined to postpone extension of this process to the ravine land of that district till funds are available and till the Kalpi experiment has given more definite results.

9. The Kalpi enterprise also owes its inception to the anxiety awakened in the tanning industry by the prospect of diminishing supplies and rising prices in the case of babul bark. In 1901, at the instance of the Army Department and in the interests of the Government Harness and Saddlery Factory, Mr. Hobart Hampden, Deputy Conservator of Forests, was deputed to investigate the problem of growing the babul for the sake of its bark. His report, while accepting the conclusion reached by the provincial Agricultural Department as to the impracticability of babul-growing in *usar* land, advocated experiments in ravine land and outlined an extensive scheme. In 1904 it was decided by the Army Department to initiate an experiment near Kalpi under the superintendence of the Forest Department. Eight hundred and seven acres of ravine land were taken up, ravines were dammed and babul sown. A recent inspection has shown that the early sowings have established themselves, the later sowings promise well, there is a vigorous crop of young plants from one to eight years old and the whole area will in another year be fully stocked. The plantation should be ready for felling by 1920 at the latest, when about 10,000 trees should be yearly available. It is anticipated that the experiment may prove financially self-supporting, but in this connection it must be recognised that the Kalpi undertaking was a pure experiment and lacked the guidance of previous results, and also that its object was the production of babul bark and not the afforestation of ravines, for which purpose there are other species besides the babul whose propagation presents less difficulty. The sowings had also to contend, in the frost of 1905 and the droughts of 1906 and 1907, with seasons abnormally unpropitious.

The experiment has in any case been valuable in indications, which will save future expense, and the Lieutenant-Governor is assured that it goes far towards proving that the afforestation of ravines is quite practicable and in all probability remunerative.

10. A most interesting experiment has also been undertaken at Thapal in the Saharanpur district by an enlightened landholder, Rai Manohar Lal Bahadur. His estate of 771 acres is situated in the Saharanpur district near the foot of the Siwalik hills and only about a mile from the reserved forests. It contains 103 acres of cultivation and about an equal amount of waste land, the remaining area being covered by poor miscellaneous forest. The soil outside the cultivated area is exceedingly poor and would have been of little value to the owner had he not adopted the wise plan of carefully preserving and fostering the existing growth and making plantations where no such growth existed. Prior to 1892 no attention was paid to the forest area. From 1892 to 1901 only very limited protection was extended to it and no definite method of treatment had been decided on. In 1901 advice was obtained from the Forest department and the miscellaneous forest area has since then been protected from browsing animals and has been worked under the system of coppice with standards, and large blanks of waste land have been planted with bamboos, shisham, eucalyptus and other trees. Altogether between 1901 and 1907 an area of about 73 acres was successfully brought under shisham. In 1908, at the request of the owner, the Forest Department drew up a working plan for the estate, and this is of particular interest as being the first attempt in these Provinces to systematise the working of a private forest. The working-plan estimated that after eight or ten years the average annual receipts would amount to Rs. 5,650 and expenditure to Rs. 3,250 or an average surplus of Rs. 2,400 and this forecast seems to be in a fair way to fulfilment. During the six years previous to the introduction of the working-plan the annual expenditure (incurred chiefly on planting work) had exceeded the revenue. This shows that the proprietor fully realised from the first that, in order eventually to realise the maximum interest on his waste land, he must first create

his forest capital. The resulting young forest is now in a flourishing condition and is under the supervision of a trained staff consisting of a deputy ranger and two guards. The owner will now have the satisfaction of reaping substantial returns from areas which would otherwise have remained unproductive waste.

11. The Forest department in the initial stages of its development was primarily a commercial department and concerned with the production of large timber; its interests were inevitably antagonistic to agriculture in that intense management demanded the exclusion of cattle-grazing. But since the time of Sir Dietrich Brandis it has been recognized with increasing clearness that forestry has a vocation no less important as the handmaid of agriculture, and that she is called to come down from the hills. Big timber need not, as Sir Dietrich Brandis urged in 1883, be the only or even the main object of a forester's existence. Among the peasants' greatest needs are firewood to replace manure, small timber for houses and wood for implements, as well as grazing or fodder for his cattle. There is therefore a place for a branch of forestry in which these commodities, regarded by the commercial forester as accessories, become the main considerations of his craft.

The Tikri forest in Gonda affords an example of the successful administration of such an area worked almost entirely for the production of fuel, both as a revenue-earning undertaking and as a valuable factor in the economy of a district. This forest now constitutes the only extensive wooded tract in a large area of high cultivation; it came under management in 1879-80. In the twelve years succeeding its reservation the total expenditure on the forest amounted to Rs. 26,750 and profits to Rs. 26,900—a ratio of over 100 per cent on expenditure. In the ten years from 1891 to 1901 the gross income of the forest was Rs. 1,22,600, the gross expenditure Rs. 68,000, and profits Rs. 54,600, or about 80 per cent on the expenditure. The average yearly profits were Rs. 5,460. Since then profits have risen substantially, reaching in the year 1902 the large figure of Rs. 17,260, while working expenses have averaged about Rs. 4,600. The produce of the forest is almost entirely fuel and grass, the former being bought in considerable

quantities by the railway. In 1902, at the time of settlement, the Government received information that the ravages of wild animals and cattle harboured in the Tikri forest had effected a material deterioration in surrounding cultivation, and the local authorities were asked to consider the desirability of disforestation. The Settlement Officer urged that, while it was a fact that deterioration had occurred from this cause and from the effects of the forest on drinking water, the value of the forest as a grazing reserve and fuel producer was so great as to render its abandonment a step of doubtful wisdom. He pointed out that wood for fuel, implements and house-building was 25 per cent cheaper in Gonda than in the trans-Gogra districts, and that this price could not be maintained if wood had to be brought from submontane tracts; he suggested that deterioration could be largely arrested by the organised destruction of wild animals, and urged that forests standing in a highly cultivated area required different treatment in this respect to forest surrounded by wild tracts. He admitted that some direct advantage to the revenue would result from the forest being brought under cultivation, estimating that in twenty-five years the revenue assessed would amount to Rs. 10,620. Systematic action was taken to reduce the wild cattle and other animals harboured, the deterioration in surrounding cultivation complained of seems to have disappeared and the idea of disforestation has been abandoned A further examination of the financial aspect of the matter produced a forecast from the Divisional Forest Officer which would show that in twenty-five years the revenue accruing from the forest will amount to over Rs. 20,000, a sum about double that anticipated from assessment to land revenue.

An extension of agricultural forestry on these lines might go far to remove the distrust of the department which has prevailed among the cultivating population by the addition of a visible policy of giving to the inevitable policy of taking away.

12. Such a development has, the Lieutenant-Governor recognises, been hitherto impracticable, owing to the inadequacy of the existing staff, an increase in which had to be justified by pointing to an increase in revenue, and owing to their necessary concentra-

tion on the settling and management of the extensive reserved forests of the province. Sir John Hewett is, however, convinced that a stage has now been reached in the economic development of the province when a systematic examination of the possibilities of afforestation is imperative. The fuel and fodder reserves at present in existence constitute an insignificant proportion of the provincial area. The whole area of reserved forest is at present about 4 per cent of the total area; the addition of the Kumaun "protected" forests will raise the proportion to 6 or 7 per cent. Of this reserve much is necessarily not available for fodder or fuel purposes. It is, moreover, largely concentrated in certain areas, and extensive tracts are situated at such a distance from the forests that the latter cannot serve as fuel or fodder reserves for them. With the agricultural and industrial development of the province a rapidly expanding demand for forest produce, and in particular for fuel, small timber and grass, must be anticipated. For the future economic progress of the people the Lieutenant-Governor *believes it essential that action should be undertaken to provide* well-distributed areas for the production of these commodities. Such action will prove increasingly difficult to initiate as agriculture and industries expand. Systematic action is at the present juncture even more urgently demanded to prevent the progressive reduction of the restricted area remaining under forest—a process which without State interference must operate with increasing rapidity. The disappearance even of private forests threatens to jeopardise the existence of the reserved forests since it tends to throw upon the latter a burden in providing grazing which they cannot hope to support. Moreover, the increasing pressure of population and cultivation upon existing reserves bids fair at no distant date to react with destructive effect on the cattle-supply of the province and, through the cattle, directly on its general agricultural prosperity. It involves, moreover, a disastrous rise in the price of timber such as is at the present moment apprehended in Europe, an apprehension which has in England lent stimulus to a national afforestation movement. In *view of the demonstrable contraction of fuel supplies in the plains* of the province and with the experience of the Punjab before

him, Sir John Hewett regards the need for definite action as imperative.

13. Afforestation is, however, a branch of forestry which differs widely from the management of existing forests, and it is a branch in which the officers of the Forest Department have as yet had little experience. The Lieutenant-Governor therefore considers it essential that, before a definite scheme of afforestation is embarked on, a systematic survey of the available areas should be undertaken and that this survey should be combined with a series of experiments on various classes of waste land with a view to determining the best methods of dealing with different soils, the species best adapted to various conditions and the cheapest and most efficient methods of propagation. It will not always be necessary to contemplate acquisition. It may prove possible to arrange with owners or communities that they should allow the Government to afforest their land in return for profits or a portion of profits.

The policy thus adumbrated may eventually necessitate the creation of an afforestation branch of the department, but the Lieutenant-Governor wishes it to be clearly understood that, even with such a development, the *rôle* of the department is not to manage the forests which local bodies or zamindars might establish, but to advise the owners in the methods of management, and to give them any assistance which they might ask. For the purposes of the present survey His Honour considers that the deputation of a single imperial officer with a small staff will meet the situation. The Lieutenant-Governor has decided to depute Mr. E. A. Courthope, Deputy Conservator, to the work. Mr. Courthope has (under the advice of the Director of Indian Forest Studies and of Sir William Schlich) undertaken a two months' tour in Europe with a view to studying examples of afforestation practice. Sir John Hewett regards his appointment as the first step in an undertaking which may prove of incalculable advantage to the province.

AN ACCOUNT OF A PORTABLE SAW MILL IN THE NORTH KANARA FOREST DIVISION, BOMBAY.

DETAILS OF ENGINE.

The engine is a 12 N. H. P., portable, by Clayton and Shuttleworth of Lincoln. The cylinder bore is 12" diameter with piston stroke 16".

The boiler pressure is 80 lbs. per square inch.

The fly-wheel is $5\frac{1}{2}'$ diameter working at 50 to 60 revolutions per minute.

It drives two 42" circular saws, and one small circular saw and a 2" band saw for cutting up waste material.

CHANGING SITE.

The mill is readily transported from place to place. It can be moved and set up in ten days, and in one season, 1902-03, the site was changed no less than three times. The main item of expenditure is the cost of carting the pieces to the mill and the lead should not be more than 4 miles, hence the necessity for frequently changing the site.

The average annual outturn for a period of six years (from 1899 to 1904) was 44,099 M.G. sleepers. During the period 1905 to 1910 the mill was not moved about sufficiently, pieces were brought from distances up to 8 miles, and the average outturn fell to 24,752. The contractors were losing money on material brought in from beyond 4 miles, consequently they failed again and again to bring in the required quanity, and finally no contractor would touch the work.

A programme is now drawn up showing the proposed positions of the mill for five years ahead, and material is being collected at these depôts. In North Kanara where labour is difficult to obtain, and contractors quite unreliable, arrangements must be made to commence collecting material at least two years ahead.

SUITABLE CLASS OF MATERIAL TO WORK ON.

The minimum girth of the exploitable teak tree in North Kanara is 7'. Almost every tree is more or less buttressed near the foot and many have suffered from fire.

Up to the year 1904 the saw mill was cutting 'Jamba' (*Xylia dolabriformis*) and for years all the hollow irregularly-shaped ends of the teak trees had been cut off and left to rot or burn in the forests. These hollow ends 3, 4, 5 and 6 feet in length were to be seen everywhere. Now the unsound end pieces are sawn off to give 6 and 7 feet sleepers. Quite 50 per cent. of these sleeper pieces would not repay the cost of bringing out to the sale depôts in the log. Many of the pieces will not yield even one M.G. sleeper, but every piece is brought in and cut up even if it will not yield anything better than logs (battens for cotton and cloth bales) measuring $2\frac{1}{2}'$ to $3' \times 2'' \times \frac{1}{2}''$ or $2\frac{1}{2}' \times 1'' \times \frac{3}{4}''$.

It seldom pays to cut up good sound logs, and saw mills in these forests should be restricted to cutting up short, unsound material not over railway sleeper length.

In 1899, 8228·16 cubic feet of good squared teak logs were cut at the mill for scantlings, the yield was—

	4352·57	cubic feet of scantlings at Rs. 3 per cubic foot, value	Rs. 13,057·71
of which	296·33	cubic feet rejected at Rs. 2, value	Rs. 592·66
	4648·90	cubic feet. Total value	Rs. 13,650·37

The timber in the rough log was worth Rs. 13,165 and the cost of sawing, etc., was Rs. 713, so that it did not pay to cut up these logs.

On the other hand, in 1902—in the Kirwatti Depôt, 800 tons of very short, crooked hollow teak logs, from which all the better logs had been selected, were cut into sleepers and small scantlings, with the result that the sawn material gave a much better return than if sold in log.

The material supplied to the mill should be restricted to unsound bottom-pieces and small top-pieces and branchwood.

QUANTITY OF MATERIAL REQUIRED.

The number of sleeper pieces required to keep the two circular benches working throughout the year, yielding 50,000 M.G. sleepers, varies much

At present the mill is in rather poor teak forests and the average yield per piece would not be quite 2 sleepers.

The number of teak trees to be felled is laid down in the working plans, and is approximately equal year by year. The average outturn per tree, however, varies much in different fellings, from 37½ cubic feet of squared log and 12 M.G. sleepers to 20 cubic feet and 5 M.G. sleepers. Usually provision is made to supply 25,000 pieces annually.

THE OUTTURN AND EXPENDITURE.

The saw mill commenced working in 1897. The outturn increased steadily from 35,000 Jamba sleepers in 1897-98 to 52,000 in 1900-01. The pay of the staff and mill-hands rose during this period from Rs. 4,579 to Rs. 5,941.

The actual outturn and expenditure for the past year 1911-12 is given on the next page.

GOVERNMENT SAW MILL AT SINGATGERI.

Outturn and Expenditure for the year 1911-12.

Details.	Outturn.			Proportion of value of outturn which may be credited to Mill.	Expenditure.	Net saving over hand-sawing.	Remarks.
	Number.	Cubic feet.	Value of outturn.				
			Rs	Rs.	Rs. a. p.	Rs. a. p	
Teak sleepers 7′ ...	458	1,002	1,832	35,684½ at 12 annas	...	...	
„ „ 6′ ...	51,369	77,053	*1,11,369				A contractor would not supply sleepers from these forests at less than 12 annas.
Bridge sleepers ...	716	1,432	3,580				
Terminalia tomentosa sleepers.	173	260	*Nil.*	*Nil.*			40,000 at 12 annas = Rs. 30,000.
Teak scantlings ...	...	768·66 at Rs. 2 per c. ft.	1,537	1,537			11,369 at 8 annas = Rs. 5,684½
Boards	...	337·7 at Rs. 2½ per c. ft.	844	844			35,684½
Battens 6′ ...	...	5,756 at Rs. 1½ per c. ft.	8,634	8,634			

*Out of 51,369 sleepers 40,000 passed sleepers ... value Rs. 1,00,000

11,369 rejected sleepers ... value „ 11,369

1,11,369

Many of these sleepers have not been inspected and the number finally passed may be nearer 45,000 than 40,000.

GOVERNMENT SAW MILL AT SINGATGERI—(*concld.*)

Outturn and Expenditure for the year 1911-12

Details.	Outturn.			Proportion of value of outturn which may be credited to Mill.	Expenditure.	Ne saving over hand-sawing.	Remarks.
	Number.	Cubic feet.	Value of outturn.				
				Rs.	Rs. a. p.	Rs. a. p.	
Battens 3′	...	43 at Rs. $1\frac{1}{4}$ per c. ft.	54	54			All the scantlings, battens, etc., are cut from waste which would be left behind in hand-sawing.
Felloes	188	...	94	94			
Slabs	About 22,000 c.ft. stacked		500	500			
Current expenditure of Mill including pay of foreman, clerk, mill hands, oil, repairs, etc.			...	...	8,034 10 5		For details of expenditure see overleaf.
Carting to Tavargatti 52,716 sleepers at one anna and 6,905 c.ft. of sawn material at Rs. 4 per 100 c. ft.			...	...	3,571 0 0		
Preparing and bringing 30,405 pieces to Depôt at 8 annas.			...	...	15,202 8 0		
Interest on cost of machinery at 3 per cent. on Rs. 10,929.			...	...	382 8 0		
Depreciation 5 per cent. for replacing machinery after 20 years.			...	...	546 0 0		The engine is 15 years old.
			1,28,444	$47,347\frac{1}{2}$	27,736 10 5	19,610 13 7	

In hand-sawing the outside slabs and hollow wood, which will not yield a sleeper, are wasted and left in the forest.

At the mill the yield of material cut from this waste material covers all sawing expenses and cost of machinery.

To compare the work of this saw mill with hand-sawing, deduct the cost of collecting and bringing the pieces to the mill, *viz.*, Rs. 15,202 from the sum which we should have to pay contractors for sawing and collecting the sleepers Rs. 35,684, this gives Rs. 20,482 approximately the monetary advantage of machinery over cooly labour.

The engine which has been working for fifteen years required new parts and the current expenditure, the details of which are given below. Rupees 8,626 is exceptionally high.

Expenditure of saw Mill from 1st July 1911 to 30th June 1912:—

Wages of Foreman, Clerk, Mill-hands.	Repairs to machinery and new parts.	Oil, rosin, ropes, waste, etc.		Fuel preparing and carting to Mill.	Miscellaneous and unusual.	
Rs a. p.	Rs. a. p.		Rs. a. p.	Rs. a. p.		Rs. a. p.
6,694 13 5	New brackets bushes, braces, centres, etc., Rs. 366-8-0.	Leather (skins).	47 6 0	592 4 0	Stationery	20 10 0
					Inspector's fee.	15 0 0
		Manilla ropes	68 15 0		Removal of stores from Mynol.	40 0 0
		Coir ...	57 6 0		Hutting repairs.	158 8 0
		Vacuum oil	256 2 0		Digging well.	156 8 0
		Cocoanut oil	133 10 0			
		Kerosine oil	15 0 0			
		Baskets ...	2 0 0			
		Chalk ...	2 4 0			
6,694 13 5	366 8 0		582 11 0	592 4 0		390 10 0

Total, Expenditure ... Rs. 8,626-14-5.

For the first five years of working, the working expenses averaged Rs. 5,000.

Cooly labour is difficult to obtain at 8 annas a day.

THE ADVANTAGES OF A SAW MILL.

The advantages of a machine over handsawing in Kanara are obvious.

In the first place with teak there is a saving of at least 6 annas per sleeper. This is derived from the saving of material, all the mill-waste being easily converted into marketable battens, etc.

While working on *Xylia* the advantages of the mill were not so great. No use could be found for the waste material and the cost per sleeper including transport to railway, 40 miles, worked out as under :—

In 1897-98 (only 2% rejected)
the cost per sleeper was—Annas 5·13 for bringing in pieces.
" 2·26 current expenditure of mill.
" 4·41 carting to Hubli, 40 miles.

11·8

In 1898-99 (18·4% rejected)	cost	per	sleeper	was	annas	14	pies	5·8
In 1899-00	"	"	"	"	"	12	"	1·7
In 1900-01	"	"	"	"	"	11	"	5·4

Average—annas 12 pies 5.

This is about 2 to 3 annas below the contract rate with hand-sawing.

With the machinery the outturn is steady and more reliable than contractors' work, the sleepers too are better cut. Sufficient hand-sawyers are not available.

DISPOSAL OF WASTE MATERIAL.

To convert the waste material a small wooden bench, which takes the old circular saws worn too small for the sleeper-cutting benches, has been constructed. Also a small band saw taking a band about 2″ wide, has been purchased for cutting curved wood for cart-wheel felloes.

The waste material converted consists of—

Rejected Teak sleepers ...	worth Re. 1 each.
Teak scantlings, 4′ to 6′ long suitable for window frames, etc.	worth Rs. 2 per cubic foot.
Battens 6′ × 2″ × 1″ ...	worth Rs. 22 per 1,000 running feet or Rs. 80 per ton.
„ 6′ × 1½″ × 1″ ...	worth Rs. 15 per 1,000, running feet or Rs. 72 per ton.
„ 6′ × 2″ × ½″ ...	worth Rs. 10 per 1,000 running feet or Rs. 72 per ton.
Boards ½″ to 1″ thick ...	worth Rs. 2-8-0 per c.ft.
Lags, battens for cotton and cloth bales 2½′ to 3′ long × 2″ × ½″ or by 1″ × ¾″	worth Rs. 2-4-0 per 100 lags.
Cart-wheel felloes cut from bent pieces about 2¾′ long, depth 7″	worth annas 8 each or Rs. 6 per set of twelve for a pair of wheels.
Teak spokes, 2½′ × 3½″ × 1⅝″ ...	worth Rs. 3 per set of 24.
Small felloes, depth 5″ ...	worth annas 5 pies 4 each or Rs. 4 per set of twelve.

The cost of cutting waste wood is trifling. As stated above, the bench is of wood and made in the mill, the saws, etc., are the old worn-out material from the sleeper saw benches.

For handling the waste material and working the bench, the following coolies are required :—

1 sawyer	at 12 annas a day		Rs. 2-2-0.
1 benchman	„ 6 „ „		
3 boys	„ 3 „ „		
2 women	„ 3½ „ „		

The daily outturn is 26 cubic feet of battens and the cost per 1,000 running feet is Re. 0-9-2 for cutting and 4 annas carting.

The 6′ battens are turned out at a cost of Re. 0-5-6 per 100 *and the 3′ battens at Re. 0-2-9.*

W. E. Copleston.

GLOWING WOOD.

The deterioration of vegetable matter gives off phosphorus which causes flashes of light often seen in marshes and damp places. No wood has, however, been heard of that is always glowing.

Last week a piece of wood was seen shining brilliantly in the forest and the light was of the same nature as that emitted by glowworms, the difference being that all the exposed surface of the heartwood was glowing; portions where the heartwood was covered with sapwood or bark were dark.

Next morning on inspecting the spot the wood was found to be a piece of the root of *Pinus excelsa*, about an inch in diameter, thrown aside, in making a road, leading to a rest-house, a little way up the hill. A large number of similar roots was collected and at night one more piece was found with a similar effect; none of the other roots, green, dry or rotting, exhibited any signs of light except the two pieces mentioned above. All heartwood exposed by chipping the bark off, glows brilliantly and the pieces of heartwood cut off in chipping, look like lucifer match sticks, rubbed and scattered all over the floor. It was found that the wood as it dries loses the property of glowing and when moistened sometimes resumes its lustre.

The pieces are in a deteriorating condition and it is likely that the glowing is due to the emission of phosphorus, but such has never been seen before. The belief of the local people is that the glowing is due to the contact of certain herbs, which glow at night, but no such herb has so far been seen, either on the spot or anywhere else as far as is known.

A piece has been sent to the President of the Imperial Forest Research Institutes and if it keeps glowing till it reaches the destination we might hear about it again.

S. N. KOUL,
Kashmir Forest Service.

"IDENTIFICATIONS OF THE ECONOMIC WOOD OF THE UNITED STATES, INCLUDING A DISCUSSION OF THE STRUCTURAL AND PHYSICAL PROPERTIES OF WOOD."

A very useful manual has recently been published entitled "Identification of the Economic Woods of the United States, including a Discussion of the Structural and Physical Properties of Wood." The author is Mr. Samual J. Record, M.A., M.F., Assistant Professor of Forestry Products, Yale University. The work is divided into two parts and contains vii + 117 pages in 8vo. with illustrations in the text and 7 full-page half-tone plates. Price $ 1·25 or 5s. 6d. net.*

The author opens with an introduction which is well worth reading. It is stated that while the book is primarly intended as a manual for forest students, it is hoped that it will also aid others in the study and identification of woods. The first para. of the introduction strikes a note which applies equally to India and America, namely, that owing to the ever-increasing demand for the better species of timber, those of less value are now finding a market and that there is a tendency amongst unscrupulous persons

* John Willy & Sons, Scientific Publishers, 43 and 45 East 19th Street, New York, and Chapman and Hall, Ltd., London, 1912.

to pass off those of less value for better varieties and hence the necessity of a key to help in the identification of timbers.

Part I deals in detail with the Anatomical Structure and Physical Properties of Wood. In discussing the great natural classes, I Gymnosperms and II Angiosperms, the author excludes Monocotyledons from the second class as relatively unimportant as timber yielding species. This is, we think, to be regretted, as though Monocotyledons cannot be classed as of great and general importance in this respect, they are nevertheless of considerable importance locally, while for a student the study of their peculiar structure is important.

The chapter on Anatomical and Physical Properties is divided into sub-heads of which 21 deal with the Anatomy and 11 deal with the Physical Property of the wood. The subject-matter in these sections of the book is clearly and concisely written and should be easy for the student to follow.

Under the sub-head "Tracheids" is given a table of length for a number of coniferous woods and a similar table is given for the wood-fibres of Dicotyledons. The striking difference in the average length of the Tracheids and wood-fibres is most noticeable, and is a point of some interest. Of 29 sets of figures of the former the maximum average length is found to be 7·00 mm. for *Sequoia sempervirens* and the minimum average 1·95 mm. for *Picea edulis*, while for the latter the maximum average length is 1·90 mm. for *Platanus occidentalis* and *Liriodendron tulipifera* and the minimum average of ·75 mm. for *Acer rubrum*.

Under the sub-head "Rays" are given two fine plates illustrating medullary rays which will give the student a clear idea of their structure, while two plates illustrate resin ducts in conifers. The question of the formation of additional ducts where wounds occur is lightly touched upon, had more been said in this connection it would doubtless have been of value and interest, especially as in America the tapping of pines for resin is such an important economic factor in the working of some of the forests.

The question of the formation of annual rings is well and clearly dealt with and to help the student two good plates are

given on page 42 illustrating sections of *Quercus macrocarpa*, while the frontispiece gives an excellent illustration of a section of a *Quercus alba*.

On pages 50, 51 and 52 is given a table of the specific gravity of 150 species of timber. The figures have been arrived at by weighing the specimens after being oven-dried at a temperature of 100° C. Looking to the systematic way in which the specific gravity of the various timbers has been determined in America, it is to be regretted that more careful attention has not been paid to this subject in India. Our text-books give much data on this point, but though it is presumed that the weighings were carried out with naturally air-dried specimens, it is by no means certain that this was always the case.

Little is said as to the mechanical strength of the various timbers, the point being only lightly touched upon on pages 53 and 54. This is an omission that we should like to see rectified in future editions of this useful publication, as after dealing with the weight, water content, shrinkage, warping, checking, hygroscopicity, etc., of timber, its strength to withstand tension, transverse strain, shearing and compression, especially with reference to the moisture in the timber, should naturally find a place. Part I ends with a useful list of publications dealing with the Physical and Technical Properties of timber.

Part II is a key to the Economic Woods dealt with in Part I. This chapter is divided into two parts, *i.e.*, I, Homogeneous or Non-porous wood; Gymnosperms; Conifers: "Soft Woods," and II, Heterogeneous or Porous woods: Dicotyledons; Broad-leaf; Hard-woods. We are not sure that we like the wooding—"Non-porous" and "Porous woods," it is somewhat confusing. The first section is further divided into—A, Wood with resin ducts, both vertical and horizontal, rays with tracheids, and B, Resin ducts normally absent; sometimes present as a result of injury, the vertical ducts arranged tangentially in a compact row. Ray tracheids present or absent. The second section is similarly divided into—A, Ring-porous woods. Pores in early wood zonate, large and conspicuous, rarely small and inconspicuous; in late wood

small or few and scattered. Rays uniseriate or widely variable Texture medium to very coarse, and B, Diffuse-porous woods Pores numerous, usually not prominent on cross section; diffused throughout growth ring instead of collected in a decided ring or zone in the early wood; occasionally more numerous and very often somewhat larger in the early wood. Growth rings principally defined by the greater density of the late woods or by the radial flattening of the outermost rows of wood-fibre; often indistinct; sometimes absent.

These sub-sections are again divided and sub-divided while in each sub-section examples are given, so that the student can with the aid of a specimen follow and so learn how to apply the key to other species.

The advisability of drawing up a key for Indian timbers has not infrequently been considered. Mr. Gamble, probably our greatest expert on Indian timbers, gave it as his opinion that it was not possible to prepare a general key with any hope of making it of practical use, and this is probably a correct view of the case. However, it is quite probable that local keys could be prepared, and were this ever contemplated it would be useful to carefully study the volume under review. The reason for stating that local keys might be prepared with advantage is that it would limit the number of species to be dealt with, while it might be found possible to prepare not local but modified keys for a given group of species such as for the conifers, *Calophyllums, Dipterocarps, Dalbergias, Albizzias, Acacias, Diospyros*, etc., which have many distinctive features and characters of their own.

Mr. Samual J. Record's book ends with a long list of references, an Index, Map of America and six full size plates illustrating the structure of a variety of timbers.

We sincerely congratulate the author on the useful, clearly written and well illustrated treatise on the Structural and Physical Properties of Wood.

A REVIEW OF THE FOREST ADMINISTRATION REPORT OF THE JAMMU AND KASHMIR STATE FOR THE YEAR 1910-11 (SAMVAT 1967).

The total area of the three classes of forests (demarcated, partially demarcated and undemarcated) under the control of the State Forest Department stood at 4,615 square miles at the end of the year as compared with 4,214 square miles at its beginning, the increase of 401 square miles over the figures of 1966 being chiefly due to the progress of demarcation in the Jammu Province and to the revision of areas consequent on more accurate surveys. Form No. 61 of the report tabulates the alterations in the three classes of forests during the year as follows :—

Class of forest.	Area at the commencement of the year.	Added during the year.	Total.	Excluded or transferred to other heads.	Area at the close of the year.
	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.	Sq. miles.
A—Completely demarcated	3,074	406	3,480	75	3,405
B—Partially demarcated ...	291	155	446	16	430
C—Undemarcated ...	849	477	1,326	546	780
	4,214	1,038	5,252	637	4,615

It will be seen from the above statement that the largest alterations in the area concern the undemarcated forests which had, during the year, 477 square miles added to them while 546 square miles were transferred to other heads, chiefly to completely and partially demarcated forests. It is not, however, clear from Form No. 61 whether the increase in the undemarcated forests represents a real gain or is simply due to periodical revisions of areas already subject to the control of the Forest Department.

The preservation of forest tracts outside the newly-demarcated areas in the Jammu Province and the formation of communal forests has not as yet received the consideration that the subject deserves, and the Conservator is justified in expressing the fear

that unless early measures are adopted to bring these tracts under a rational system of working, their disappearance is merely a question of time.

Good progress is reported in demarcation and surveys, but the latter work is evidently confined to boundary surveys and to enlargements from the Atlas sheets, the only maps available at present. These contain but few topographical details. The Darbar will, no doubt, avail itself of the opportunity afforded by the topographical survey operations of the Survey of India which are now in progress in the State, to procure accurate forest maps, but it means the complete demarcation of each forest area before the Survey of India takes it in hand.

Progress in the preparation of working plans has kept pace with other improvements, and 31 per cent. of the entire forest area is now being worked under their provisions. Of the four completed working plans, however, only one has yet received the sanction of the Darbar.

There is a decrease both in the length of paths constructed and the amount spent on road work as compared with the work done in the previous year; and although more has been spent on repairs the amount (Rs. 1,516) seems still too low, considering the hilly nature of the country and the damage caused to roads and bridges by snow and floods. The Conservator notes that the opening and keeping up of means of communications in the remoter parts of the country is done at the sole cost of the Forest Department. Why should not the Revenue or Public Works Department of the State defray a portion of the cost of construction and of the maintenance of those works, as is usually done in India?

The progress in the construction of new buildings to house the Forest establishment and in keeping existing buildings in repair is most satisfactory, and should, if continued, result at no distant date, in better protection and increased revenue to the Darbar.

There was a recrudescence of forest offences as compared with the decrease in the previous year, there being an increase of 54 cases. The percentage of convictions in court cases fell from

32·7 to 23·95. The decrease in the previous year was attributed to more liberal grants of forest produce to the tenantry. The present increase is put down mainly to unauthorised fellings.

The Conservator has some strong comments to offer about the delays of courts in disposing of forest cases, and justly remarks that such delays practically ensure acquittals. Convictions obtained long after the dates of occurrence of offences cease to act as deterrents and are in so far of little value in preventing damage to the forests. The remedy for this undesirable state of things lies, as has been proposed by the Conservator, in granting powers of arrest to forest officials and in admitting evidence taken down by Divisional Forest Officers in a court of law; but evidently these proposals have not yet received the sanction of the Darbar. It will also improve matters if the Darbar or the High Court of the State were to pass an order making it obligatory on subordinate courts to dispose of forest cases within a fixed period from the date of institution of proceedings in each case.

The continued success in protection from fire is noteworthy, the total area burnt being only 3,367 acres. At higher altitudes the forests are more or less self-protected, this dispenses with the necessity of special protective measures, but in the low-lying chir forests of the Jammu Province which are very inflammable special measures are required every year to keep out fires; and it is in these areas that the damage caused by forest conflagrations has been more marked. The expenditure of Rs. 718 incurred on fire-protection appears far too small to ensure success in this direction.

Grazing is practically unrestricted over the whole forest area of the State and is entirely under the control of the Revenue Department. The Forest Department is, however, authorised under certain restrictions to close up to one-fifth of the total forest areas, and we should like to see effect given to this.

Damage caused by bears to young trees of deodar and blue pine is said to be serious in many localities, but Forest Rangers are not allowed to shoot the animals. In the case of similar damage in the hill forests of North India, Rangers are encouraged to shoot.

black bears by offers of rewards of Rs. 20 or more per animal shot.

Natural regeneration of deodar and blue pine is reported to be generally good in the lower zone of coniferous forests but that of the firs is said to be poor in the higher zone. Various causes are assigned for the paucity of new growth of firs of which density of cover overhead, severity of climate and over-grazing are the chief. Of introduced exotics *Robinia pseudoacacia* and the Hardy Catalpa promise success, but the species of Eucalyptus have proved a failure.

Root-cuttings of kuth (*Saussurea lappa*) have been fairly successful at Pahalgam, but sowings at Kodara are said to have failed. Kuth seed, if collected when mature, *i.e.*, in the beginning of November, germinates readily within a month from the sowing, but the habit of the young seedling is somewhat different to that of the mature plant, and possibly many young plants may exist where none are believed to occur at present. These plantings and sowings of kuth are being made by the Forest Department in the interest of the Revenue Department which forms the revenue from this source although kuth is strictly a forest product.

In two out of the nine Forest Divisions major forest produce is exploited on the selection system under the provisions of working-plans ; elsewhere improvement fellings, as prescribed by working-plans, and unregulated fellings, are the methods employed. The latter method of working will no doubt give place to more scientific methods as more forests are brought under systematic working, but the regulation of felling for free grants of timber where limited forest areas are set aside for this purpose may present difficulties in times to come. The selection fellings yielded 1,334,631 solid c.ft. of timber from 11,859 deodar and pine trees, or 112·5 c.ft. per tree.

It is interesting to note the increase in revenue from sales of minor produce. In the list of produce exploited species of edible fungi (*Guchhi*) which are exported to the Punjab annually in large quantities do not find a place. Probably they are farmed by the Revenue Department of the State.

Exclusive of free grants departmental agency was responsible for 24 per cent of the timber exploited ; this shows a decrease of 1 per cent over the preceding year's figures. Free grants to the tenantry absorbed 72,935 c.ft. of timber and 15,759,279 c.ft. fuel, but the latter is only an estimate. Messrs. Spedding and Co. hold the timber monopoly in Kishtwar and Kishanganga, and paid on an average Rs. 55-15-5 per deodar and Rs. 10-11-2 per blue pine tree. These rates appear low as compared with the rates for similar trees in North India.

The total outturn in timber and fuel was 28,715,227 c.ft. as compared with 39,074,994 c.ft. of the preceding year ; the decrease was chiefly under removals by purchasers and concessionists. Exploitation by State agency resulted in an increase of 42,536 c.ft. in the outturn of timber, but in a decrease of nearly one lakh c.ft. of fuel.

The gross revenue of the year was Rs. 18,02,879 as compared with Rs. 17,08,464 and the surplus showed an increase of Rs. 87,939 over that of the preceding year, and of Rs. 3,28,576 over the average of the five past years. The increase is attributed to larger sales of timber in the Chenab and Jhelum Divisions which are the sale depôts for supplying the Punjab markets.

The percentage of total charges to gross revenue was 28·31 against 29·50, and the percentage of B. Establishment charges to gross revenue was 11·96 against 12·31 of the previous year. It is to be noted, however, that of the total expenditure of Rs. 2,94,768, departmental operations under AI, are responsible for Rs. 2,02,221, leaving a balance of Rs. 92,547, or 5·13 per cent of the gross revenue for works of improvement.

Notwithstanding the larger sales in the Chenab and Jhelum Divisions the rates obtained were lower all round than in the preceding year indicating either a glutted condition of the timber markets or possibly a deterioration in the quality of timber exported.

The strength of the establishment rose from 764 to 793 in the year under review, but the increase was chiefly in the number of office peons, and the number of Rangers, although increased by

two, is still inadequate for the 42 Ranges into which the forests have been lately divided. This deficiency is, however, being made up by sending every year suitable candidates for training to the Dehra Forest College and in a few years all the ranges should be in charge of trained Rangers.

The charge of the State forests was held by Mr. W. H. Lovegrove, I.F.S., till about the close of the year, but the report was written by Mr. R. C. Milward, I.F.S., who officiated as Conservator during the former's absence on leave. The report embodies a concise and clear exposition of sustained progress in various directions, and both the Darbar and the Conservator are to be congratulated on the success of the year's administration.

The Conservator's charge with its ten Divisions, comprising an area of nearly 3,400 square miles of a mountainous country, appears, however, to be excessive and the physical importance of the areas, their efficient control with a view to increase the revenue and the welfare of the population depending on them alike seem to call for two Conservators. As has been remarked before, the State has been very fortunate in securing Mr. Lovegrove as its Conservator. Under his administration, although still much remains to be done, progress has been very marked and the state of the forests to-day is very different to what it was not so very many years ago.

THE FORESTS OF THE PHILIPPINES.

There is an interesting sketch of these forests in the *Scottish Geographical Magazine*, which we print below :—Professor Paul Goode contributes to the *Bulletin* of the American Geographical Society a paper on this subject, based upon the publications of the Philippine Bureau of Forestry. Of the 120,000 square miles which constitute the total area of the archipælago no less than one-third, or 40,000 square miles, remain in the condition of primæval forest. About 20,000 square miles are covered with a second growth of forest, 48,000 square miles are in grass land, and only 12,000 square miles are under cultivation. Of the cultivated area, not

more than half is under cultivation at one time, so that the total population of the islands, about 8,000,000 persons, is supported by the cultivation of only 5 per cent of the area. The origin of the grass lands is exceedingly interesting. In order to prepare land for cultivation the trees are partially cut down, and the branches, etc., after drying, are fired; rice, sweet potatoes, Indian corn, etc., are then planted in the soft ash. But after one or two crops have been taken off, the cogon grass begins to take possession, and its network of roots and its rank growth make it impossible with primitive implements to get a crop from ground which it has invaded. The patch is therefore abandoned, and a new clearing made, so that the grass land is continually extending. The fact would be of less consequence were it not that the grass is practically useless for fodder, and thus these lands are unproductive. Under natural conditions the forest would doubtless encroach upon the grass, but here again man interferes. His forest fires destroy all young seedlings, for in the dry season these areas of rank grass burn rapidly, though the grass springs afresh after the burning. Obviously then the administration has some serious problems before it.

The forests themselves are arranged under a number of different headings, but the important point is that they resemble tropical forests in general in their great number of species. It is estimated that some 2,500 species of trees occur, and in one case no less than eighty species were counted in an area of one acre in extent, while of these only two reached a merchantable size when mature. Fortunately, however, the Dipterocarps, which reach a great size and can be used to furnish construction timbers, tend to occur in pure stands, in a fashion that will justify the use of modern logging methods. In all about one hundred species may be reckoned on as of commercial value. Meantime a large amount of timber is imported into the archipælago from America. Among the minor forest products it is noted that there are hundreds of square miles of nipa swamps, and the sap from the flower stalk of this palm has a very high sugar content, and can be used to produce commercial alcohol.

COLONEL BAILEY, R.E.

At the Summer Graduation Ceremony at Edinburgh University on 5th July, the degree of LL.D. was conferred upon Colonel Bailey, R.E., formerly Secretary of the Royal Scottish Geographical Society and Lecturer on Forestry in the University.

The Dean on presenting Colonel Bailey for the degree, said:—

"Our late Lecturer on Forestry, while still a young officer in the Royal Engineers, was attached to the Indian Forest Department, where his thorough and excellent work earned high official commendation. As Superintendent of the survey branch, he originated the system of training intelligent natives to perform surveying work previously reserved for the European establishment, thereby effecting important economies. He organised a new Indian Forest School; for some years he supervised the British students at the French Forestry School at Nancy; and he was acting as Inspector-General of Indian Forests when he was invalided home in 1890. Edinburgh was then the pioneer among British Universities in providing a scientific education in Forestry and she gladly secured for her lectureship Colonel Bailey's unique training and ripe experience. The success of his course on the principles and practice of forest management is attested by the number of his pupils who now hold important appointments at home and abroad. To his initiative we owe the institution of a degree in Forestry, which promises to do much to foster and encourage the scientific study of the subject."—[*Scottish Geographical Magazine.*]

CIRCULAR No. 6-2-12.

FROM

F. BEADON BRYANT, ESQ., C.S.I.,

Inspector-General of Forests to the Govt. of India,

TO

ALL CHIEF CONSERVATORS, CONSERVATOR,

Except Madras and Bombay.

SIMLA, *the 9th July* 1912.

SIR,—I have the honour to inform you that, after considering the replies received to my Circular letter No. 14, dated the 19th

December 1911, regarding the special surveys of small blocks of forest areas, I have decided that it is not possible to lay down any general rule regarding the size of forest areas which should be surveyed by the Forest Department when special surveys are considered necessary. The existing rules regulating the procedure to be followed in dealing with forest surveys, which were promulgated with my Circular letter No. 7-159-7, dated the 29th April 1910, require the previous sanction of the Government of India before special surveys can be undertaken (see Rule III) and should adequately guard against such surveys being carried out by the Survey Department where they can be done sufficiently well by local agency. These rules should be strictly adhered to and Conservators should arrange to carry out any special surveys required by local agency so far as this can be done with sufficient accuracy for the purpose required.

2. As regards suggestions made by certain officers in their replies to my Circular referred to above, to the effect that special surveys by the direct agency of the Survey of India Department might be rendered unnecessary in some cases if that Department could lend a survey officer to supervise the work of local surveyors, or if trained Indian surveyors with small parties could be placed at the disposal of the Forest Department to survey small blocks of forest, a copy of a letter* from the Surveyor-General, showing to what extent it may be possible to provide assistance in the directions indicated is forwarded herewith.

*No. 715-T., dated 29th June 1912.

I have the honour to be,

SIR,

Your most obedient servant,

(Sd.) S. CARR,

for *Inspector-General of Forests.*

Copy of a letter from Colonel S. G. Burrard, C.S.I., R.E., F.R.S., Surveyor-General of India, to the Inspector-General of Forests, No. 715-T., dated the 29th June 1912.

WITH reference to paragraph 3 of your letter No. 465-2-10, dated the 30th May 1912, I have the honour to state that this Department is too short-handed to lend survey officers for supervising purposes. Arrangements might, however, be made to lend the services of surveyors if their work was supervised by forest officers. But the Department is very short-handed even in the case of surveyors, and Survey Superintendents will demur at having their surveyors taken away. So applications for the loan of surveyors would have to be scrutinised and only made in really special cases. They would also have to be made at a certain fixed time each (May for preference) so that survey programmes could be arranged accordingly.

CIRCULAR No. 7-75-6.

FROM

F. BEADON BRYANT, ESQ., C.S.I.,

Inspector-General of Forests to the Government of India,

TO

ALL GOVERNMENTS AND ADMINISTRATIONS.

SIMLA, *the 10th July* 1912.

SIR,—With reference to Government of India Resolution No. 10F-76-3, dated the 22nd June 1912, regarding the inauguration at the Forest Research Institute and College, Dehra Dun, with effect from the 1st November 1912, of an entirely separate two years' course of instruction for candidates for direct appointment to the Provincial Forest Service, and rule 18 of the College and Institute admission rules, I have the honour to intimate that, owing to the short notice given, the President of the Institute will not hold *in the present year* any examinations in English and Mathematics. As an exceptional case, however, a course in Mathematics will be given at the Institute, possibly in the place of

the Zoology Course. In future years the rules as sanctioned by the Government of India will be strictly adhered to.

2. It is requested that all applications for nominations to join the 1912—14 class may reach the President by the 1st September next.

I have, etc.,

(Sd.) S. CARR,

for *Inspector-General of Forests.*

CIRCULAR No. $\frac{13\text{-F.}}{190-1}$.

FROM

H. B. HOLME, ESQ., I.C.S.,

Under Secretary to the Government of India,

TO

ALL GOVERNMENTS AND ADMINISTRATIONS.

SIMLA, *the 3rd July* 1912.

SIR,—I am directed to invite a reference to paragraphs 1 (*b*) and 3 of this Department's Circular No. 7-190-24-F., dated the 24th April 1911, dealing with Resolution No. XIII passed by the Board of Forestry in March 1910, in which it was recommended that selected forest officers should be allowed to visit Dehra for the study of any particular subject in which they desire to carry out research work. It will be seen that the matter was left over for further consideration. Two years have now elapsed since the Board of Forestry made their recommendation, and during this time work at the Forest Research Institute has made great progress. The Government of India consider it is of great importance that all gazetted forest officers should be in touch with the Research Institute and keep themselves acquainted with the work and investigations which are in progress there, and, though deputations for special study have not yet been arranged for, they would be glad to see all promising officers encouraged to pay short visits to Dehra of, say, ten days or a fortnight, during which

time they would be able to inspect the Museums, the Chemical Laboratory and the Herbarium. They would thus gain a general knowledge of the investigations which have been and are being undertaken—and of the wide-spread effects that these may be expected to have on the sylvicultural treatment of the forests and on the development of forestry in genera .

2. Should it be considered desirable that an officer should pay a more extended visit to Dehra for some particular purpose or with some special object, *e.g.*, to consult the herbarium in connection with the preparation of a local 'Flora,' it will be open to local Governments to allow him to do so, and the President, Forest Research Institute, will endeavour to give him every facility for prosecuting his enquiries. During such period of deputation officers would receive their full pay and allowances, and may be allowed travelling allowance to and from Dehra Dun, but no daily allowance during halt there. The most convenient time for such visits would be during the monsoon, July to October, and

His Excellency the Governor in Council
I am to suggest that with the permission of His Honour the Lieutenant-Governor
your permission

any forest officer who wishes to do so, and who, it is considered would profit by such visits, may, after consultation with the President, Forest Research Institute and College, be allowed to visit Dehra on duty for the purpose set forth above.

I have the honour to be,

SIR,

Your most obedient servant,

H. B. HOLME,

Under Secretary to the Government of India.

VOLUME XXXVIII. NUMBER 12

INDIAN FORESTER

DECEMBER, 1912.

TEAK AND BAMBOO IN BURMA.

In the *Indian Forester* for August 1912 Mr. Leete has emphasised " the necessity for taking the flowering of the bamboo as the pivot on which to hinge all schemes for improvement of the forest, with teak regeneration as the main objective." It is, I think, generally found that when a subject has been well ventilated, and time has been allowed for verifying the suggestions public opinion will tend, perhaps slowly but inevitably, in the direction of the truth ; and to my mind therefore it is significant that although this view has been strenuously advocated by Mr. Ribbentrop and others, it has not gained in favour, but on the contrary tends to fade gradually into obscurity. I understand, however, that Mr. Leete desires further discussion of this view, but although I appreciate his kind reference to myself, I hope he will not take it amiss that I should nevertheless attack many of his suggestions in my usual savage and uncouth manner.

2. Although it may be denied that we have generally a tendency to imagine and to distort facts to fit in with a particular

view, yet there is, I think, no disputing that it is far sounder to ascertain exactly and correctly what the facts are first, and to draw conclusions from them. After Mr. Leete's interesting description of the effects of fire-protection, it is perhaps superfluous to point out that if it is desired to study teak in its natural and normal state, attention should be confined to unprotected forests. Before, however, discussing the question of reproduction at the time of the flowering of the bamboo, I wish to draw attention to a few facts regarding the peculiarities of teak reproduction at other times. These can be readily verified, and I think throw some light on the whole question of reproduction.

3. We are, I think, unconsciously influenced by the fact that in a Taungya plantation germination invariably takes place almost immediately. We are also accustomed to reliable germination in Europe, where if conditions are created favourable to germination, it is not unusual to find two or three hundred seedlings per square yard. In Burma, however, although we know that teak seedlings spring up naturally in gaps and in places where the cover is sufficiently open, and although, so far as I can see, there is no earthly reason why it should not be possible to get successful results from dibbling teak seed in such places, yet the fact remains that although the experiment has been tried hundreds of times, no one has, so far as I am aware, been able to attain success. This points to the conclusion, and I think other evidences could be produced, that the germination of teak is very erratic. It is a matter that is apt to be overlooked, but as it has upset many calculations, it should be borne constantly in mind. It is details such as these which defeat the most attractive schemes when put into practice.

4. Another point to which I wish to draw attention is the fact that the growth of a teak seedling is also very erratic and unexpected. A very common type of seedling is one with two large conspicuous leaves with a thin stem about two feet high, and from our experience of Taungya seedlings we are, I think, apt to assume that this stage is reached in one year. It has also been constantly reiterated, although there is no foundation for the

statement, that "it takes a seedling ten years to establish itself against fire", and this has, I think, given rise to an impression that the kind of seedling described is from one to ten years old, and that the size of larger seedlings and those with woody stems corresponds with their ages. The age can be ascertained fairly approximately by cutting a section through the top of the tap root, and in order to get rid of wrong impressions and to ascertain the true facts, I would strongly advise any one who has not done so, to determine the age of a few seedlings in this way. It would, I think, be found that one and two-year-old seedlings are extraordinarily hard to find, the reason being that as growth is very much slower in the jungle than in a Taungya, the seedlings are at first very small and inconspicuous. It would also be found, I think, that seedlings are affected in the most extraordinary manner by shade, growth frequently on this account being almost stopped, and it is for this reason that the appearance and size of seedlings is so deceptive. Reproduction, for instance, which appears even-aged and to have originated a few years ago, is sometimes found to have been spread over a period of thirty or forty years, which is a further proof of slow and erratic production; and again in a protected area where the influence of fire is eliminated, it is often found that the existing seedlings, although small, originated before the area was protected and have been retarded by the shade; and in fact it is usually difficult to find seedlings which have originated under protection. On the other hand, fire alone does not seriously retard the growth. This is proved by the statistics in the next para., the first of which relates to seedlings in an unprotected area where the seedlings had free access to the light, but were exposed to not less than the ordinary risk of fire. At the same time, however, and this counteracts many of the disabilities under which they suffer, although the growth is affected so greatly by shade teak seedlings appear exceedingly tenacious of life, and can endure a considerable amount of shade for many years without being killed.

5. The following statistics recorded in an experiment carried out for that purpose throw some light on the effect of

the flowering of bamboo on teak seedlings already on the ground :—

	1st plot.	2nd plot.
Height at time of flowering ...	2′ 3″	4′ 0″
Height in second year ...	5′ 9″	6′ 1″
Height in third year ...	9′ 2″	8′ 10″

This appearance even more than the actual measurements gave evidence of the wonderful manner in which they respond to the removal of the bamboo canopy. From being sickly and unpromising the seedlings soon looked as healthy and vigorous as any *Taungya seedlings. The fact that a great many* saplings are found kinked at the level of the bamboo canopy seems to indicate that seedlings frequently do penetrate the canopy, but nevertheless I am inclined to the opinion that the principal factors favouring natural regeneration are the natural removal of the bamboo canopy at periodic intervals, and the tenacity with which they cling to life between the intervals.

6. I myself am perhaps inclined to under-estimate the damage caused by mild leaf fires, but although I have ventured at times to express an opinion *that fire-protection against mild leaf* fires was showing an unnecessary and too tender a solicitude for a very sturdy and hardy species, yet I have always considered that when the bamboo flowered and died, the circumstances were entirely changed. At such times there is an extraordinarily large amount of inflammable material, and therefore it has always seemed to me peculiarly surprising and inconsistent that instead of protecting them more vigorously than ever until the dead stems had disappeared, it should have been contemplated that at such times only the forests should *be deliberately fired. My experience* of a *Myinwathon*, however, caused me to reconsider my views. By the third year the bamboos had become rotten and began to.

fall over, and it was found that in the unprotected area the seedlings, which I have described as so promising, were badly injured. In some cases the seedlings, although sufficiently vigorous to resist an ordinary leaf fire, were burnt back to the ground, but in such cases of course little harm was done. In a great many cases, however, the leading shoot was destroyed, or the seedlings were burnt on one side, or damaged in such a way as seriously to impair their value. It was, in fact, evident that if a *wathon* area were not protected, it would be necessary to go thoroughly over the area to carry out prunings and clearings. If however the effect was distressing in the unprotected areas, it was appalling in the areas protected from fire. In many cases whole clumps of bamboos had fallen over, and a large proportion of the seedlings were bent over to the ground. They were of course not killed, and a side branch from the middle of the bend promptly developed as the leading shoot, but it was evident that their value was destroyed. Whereas the damage to the seedlings in the unprotected areas could be repaired, there was such a litter and mess in the protected areas, that if a *wathon* were extensive, as will be the case when the Kyathaung flowers, it would be impossible to get over much ground in order to attend to the seedlings.

7. As regards the question of natural reproduction of teak at the time of the flowering of the bamboo, teak is a light demander and it seems, therefore, reasonable to expect, and perhaps preposterous to doubt, that natural regeneration should be very greatly stimulated by the removal of the bamboo canopy. If, however, we are to act on this theory, it seems only reasonable to insist on clear proof that particular abundance of reproduction has actually been caused by the flowering. Mr. Leete maintains that "we should recognize the fact that Nature provides us with excellent regeneration at special times every 30 to 50 years," yet although he gives us to understand that three different species of bamboos have been flowering in his division within recent years, he fails to state whether this has resulted in any reproduction whatever. Personally I have seen several *wathon*

areas, but have never noticed any particular abundance of reproduction having originated in consequence of the flowering of the bamboo, and although bamboos have flowered within recent years throughout the Northern and Southern Circles, I cannot recall any authentic instance in which such has been recorded. Corroborative evidence can be obtained from *Kyathaung* forests where it is known that no flowering has occurred since 1852. This bamboo flowers simultaneously and gregariously over large areas, and only at very rare intervals. According to Mr. Leete's theory therefore, it should be possible to find clear and distinct age gradations corresponding with particular abundance of reproduction in 1852 and in other years of flowering, but if he were to attempt to find these age gradations, and to calculate from them in what years flowering had occurred, he would find, I think, that they did not exist, and would realize perhaps that he has allowed his imagination to run away with him. As one or two-year-old seedlings are very hard to detect, the fact that I have not noticed any reproduction caused by a *wathon*, does not satisfy me that none does occur at such times. I remember, however, noticing some remarkably true reproduction of teak in an old *wathon* which appeared to be a genuine case in point. It was not, in fact, until I examined the rings in the tap root, that I discovered that the reproduction had originated previous to the flowering, and I wish, therefore, to emphasize the desirability of distinguishing carefully between advance growth and reproduction caused by a *wathon*. I am however on surer ground when I express the opinion that the reproduction caused by a *wathon*, if any occurs, is of little importance, and that it is on the reproduction which springs up between the intervals of flowering on which we have mainly to rely.

8. A small point which is easily overlooked is whether, assuming that a certain amount of reproduction were found to be caused by a *wathon*, it could compete successfully with the new bamboo crop which springs up at the same time. In the forests of which I have had experience the *Tin* has struck me as a very inferior bamboo which has ordinarily dragged out a miserable

existence under the *Kyathaung*, and has only attained a fictitious importance in protected areas. It is, therefore, I think, not so typical a bamboo as the more social *Myin* and *Kyathaung*. Brandis estimates the maturity of *Kyathaung* at about 8 to 12 years, and this accords with the tradition recorded in "the log" from Bassein in connection with the flowering of 1892. As regards *Myin*, although slow growing and susceptible to fire for a few years, yet after about 5 to 10 years it generally becomes dense and develops quickly. I quite agree with Mr. Leete that the growth of bamboos is frequently erratic. The new crop of bamboos, I think, frequently has difficulty in establishing itself in many places owing to a dense growth of weeds, which would however also affect the reproduction of teak, but while I do not think that *Tin-wa* would ordinarily cause much trouble to teak reproduction, I am inclined to think that the latter could not compete successfully with a new crop of *Kyathaung*, or even with that of *Myin*. As shown by Mr. Leete, with fire-protection the competition would be hopeless, and might even affect advance growth.

9. There is of course always the chance that our sowings may be successful, while Nature's amateurish efforts fail. My experience is based mainly on the opportunities I had to observe, near the headwaters of the Myittha, the effects of a flowering which advanced over the greater part of the Chindwin some years ago. The Sub-Divisional Officer stationed at Ganjaw dibbled in a considerable quantity of teak seed, and at the same time carried out several experiments to test various views and to collect definite information. In one plot where the dead stems were cut and burnt, and the conditions assimilated therefore to a Taungya plantation, some success was attained ; but dibblings, sowing broadcast with and without hoeing, etc., seemed very uncertain and practically useless. Returning to my headquarters at the end of the season *viâ* Mingin and Mangrove, I was able to hear what was being done in other Chindwin Divisions. It appeared that although extensive dibblings had been carried out, the results had proved unexpectedly disappointing. There appears ample light for reproduction at such periods, and I can only suggest that the lack of success is due

to the cussedness of teak, and to the fact that by procrastination it loses a favourable opportunity.

It has never been contended that the measures proposed for the treatment of the *Kyathaung* forests were not equally suitable for more modest bamboos, and as most of us have come across *wathons* at some time or another, it can hardly be doubted that *wathon* sowings have been frequently attempted. It is not certain that had the results been successful they would have been recorded with a great flourish of trumpets, and is it not probable that the lack of interest which Mr. Leete is so anxious to dissipate, is due to the fact that when putting this view to the proof, we have found that it does not come up to our expections?

10. Mr. Leete appears to base his conclusions entirely on a statement made by Mr. Lace. It is not quite clear whether teak seed was dibbled in at a small cost and proved more or less successful, or whether a certain amount of reproduction sprang up merely as the result of refraining from fire-protection, but apparently little importance was attached to the result either way. The point he emphasized was that the reproduction which originates before flowering is adequate, and that nothing further is required. So far from justifying Mr. Leete's conclusions therefore, this opinion supports the opposite view, that it is the reproduction which originates between the intervals of flowering and when the bamboo is mature, which is the more important and on which we have mainly to rely. Mr. Leete's opinion, therefore, appears to be simply that provided we dispense with fire-protection reproduction is ample, but that at the time of the flowering it is desirable further to carry out prunings and clearings in order to repair the damage caused by the destruction of the dead, flowered stems. Mr. Beadon-Bryant has confined his attention principally to *Kyathaung* forests. He published excellent photographs showing typical reproduction between the intervals of flowering, and emphasized the fact that the one thing needful in this class of forest to ensure adequate reproduction, is to abolish fire-protection, and I may perhaps be allowed to add that this is also my own humble opinion.

11. Mr. Leete touches on the question of repairing the injury which has already been caused to natural reproduction. An Indian Conservator who of course regarded fire as his natural enemy, expressed the opinion that we could make good any loss caused by protection by the axe, the saw, and the *da*, but his statement at once roused a storm of protest from Burma Officers of practical experience. Mr. Beadon-Bryant voiced the general opinion regarding this point when he stated that " the hand of man can in this manner influence but to a small degree the forces of Nature." " It would," he continued, " be equally easy to stop the tide as to keep down the inferior species and bamboos which fostered by fire-protection are impossible to control." Mr. Leete emphasizes the fact that when the bamboos are thoroughly established they scoff at fires, and it seems therefore that the only thing to be done is to wait patiently until the next flowering acts as a spring cleaning, and again further until the new crop of bamboos attains maturity, when reproduction of teak will again creep in gradually.

12. There are one or two minor points on which I feel moved to hazard an opinion. Mr. Leete states that "as no one knows the rates of mortality it is not easy to say whether any class is sufficiently well represented to keep up to the level of the next above it." I would commend to his notice two useful branches of knowledge, a smattering of which is, I think, more useful in a tropical forest than the whole Science of Artificial Forestry, namely, the knowledge accumulated with respect to the struggle for existence, and that accumulated for actuarial purposes. He must be aware that in a census report the table of population classified by ages constitutes a rough actuarial table, in which the differences in numbers represent the natural mortality between the ages. This is due to the fact that mortality is constant. It may seem highly fantastic that in the struggle between human beings and bacilli the scale should be so delicately balanced as to result in constant mortality, but he will find this point clearly illustrated and in a popular manner by H. G. Wills in "The Martains ". In a natural forest the struggle for existence is more direct, one species competing with another similar species, and

Mr. Leete must know that serious scientific men accept the fact that this has resulted in the course of centuries in a stable balance and in constant mortality. It therefore follows—and if Mr. Leete is still sceptical, I would advise him while he is on leave to consult a learned professor on this point—that an enumeration of teak on a sufficiently large scale, and if classified by ages, must also similarly form an actuarial table for teak, and if he examines the statistics collected for working plans he will find that the age classes are graduated, and that the older age classes decrease in numbers in the manner one would expect on this view. He may not have noticed that as more progress is made, instead of attempting to regulate the yield by volume as advocated by the Sylviculturist of the Research Institute,* opinion has hardened in favour of regulating the yield by area, and that instead of calculating the normal yield on the whole growing stock which would be the only sound method if the age gradations were irregular, it has become the invariable practice to base the calculations on one age gradation only. If, however, Mr. Leete were to assimilate what is known regarding the consequences of the struggle for life, he would, I think, discover the reasons for many conclusions we have arrived at slowly as the result of practical experience. He would, I think, realize that not only could the rates of mortality be calculated, but also that reproduction must be adequate to maintain the species, that there must be a normal series of age gradations, that the distribution must vary with the rainfall, soil, and other similar factors, and would find, in fact, that many of his difficulties and anxieties would disappear, and although he may prefer the attractions of an artificial forest, would discover, I think, that even a Burma jungle is not without interest.

It is unfortunate that large and unequal age or rather girth classes have been adopted in Burma. At present we enumerate seedlings and saplings although the statistics are never utilized for purposes of calculation. We seem to be slaves of custom, but to my mind it would be quite sufficient, and more simple, if one party only made complete enumerations with one foot girth

* *Indian Forest Records*, Vol. I, Pt. IV.

classes and counted every tree, while the other parties enumerated only trees over 5 feet in girth. The work would be done more rapidly, and yet it would be possible to prepare more detailed actuarial tables and to calculate the rates of mortality more accurately. If then the age classes were irregular in any forest, the fact would be brought more prominently to our notice, and lead us to seek for an explanation.

13. Mr. Leete raises the question whether it is sound policy to attempt to improve all our forests. He may be aware that there is a prejudice against landowners, who, having a monopoly of the land in a neighbourhood, hold up the land "to ripen". From a *quasi*-commercial point of view there are perhaps attractions in taking over the finest blocks of forest, and in being able, when the unclassed forests are exhausted, a process accelerated by reservation, to make our own terms for forest produce, but it was certainly not with these intentions that large blocks of forest were reserved. As a question of general policy, therefore, I think, if he considers the question, he must come to the conclusion that it is essential that, except in special cases where there are reasons to the contrary, we should attempt to do some thing with all our reserves, or if the task is beyond our powers, that we should abandon the superfluous portions which would then be of use in helping the modest requirements of the humble villager to be satisfied. In my opinion, however, the area is not excessive nor beyond our powers, provided that we consider practicability and do not attempt too elaborate and ambitious schemes.

14. A new recruit who desired to take an intelligent interest in his work would find, I think, the greatest difficulty in ascertaining what we are supposed to be driving at, and in discovering the facts on which our actions are based. We have, I think, no clear and definite policy, and at present seem to be merely drifting. For the last fifteen years at least we have been leisurely chewing the cud of reflection on the subject of fire-protection, and no sooner do we seem to be getting rid of the delusion that this is a universal panacea, than another red herring is dragged across our path in the shape of the uniform system and elaborate schemes for

establishing reproduction. It was officially recognized several years ago that fire-protection affects reproduction prejudicially, and it seemed to me that we were singularly unwise to ignore the fact that adequate reproduction is the basis of forest conservancy. It seems to me now, however, that we have suddenly gone over to the other extreme, and are displaying too great an anxiety about reproduction. We have to take a few simple facts into consideration. I have endeavoured to show that teak is "uncertain, coy, and hard to please", and that it has not yet succumbed to our cajoleries. This merely bears out what has been previously stated with more dignity, and although the opinion attracted great attention without contradiction, that with regard to reproduction "our somewhat costly Taungya system is the only one on which we can place reliance." Even therefore if we have the desire to carry out elaborate schemes to effect artificial reproduction, have we the knowledge?

15. We have also, I think, to determine whether there is any urgent need to establish any artificial reproduction. It is, I think, evident that no species *could exist in a natural forest unless it* reproduced itself in sufficient quantities to maintain its numbers in spite of the immense mortality to which it is subject, and referring to working plans statistics we have definite proof that in every forest there is an enormous preponderance of seedlings. Ordinarily, therefore, there would appear to be no necessity to resort to artificial reproduction, but the question has been complicated by the introduction of fire-protection. It is evident that we have now only the choice of two alternatives, either we must abolish fire-protection in which case we can rely on sufficient reproduction, or if we retain fire-protection, we must make good the loss of natural by artificial reproduction. I have laid myself open to facetious remarks regarding the great importance I attach to this question, but I am sure that any one who attempts seriously to follow the progress of sylviculture in Burma, must admit that it is a question on which we have got to make up our minds some time or other, and that the sooner we do so the better.

16. As regards the particular measures involving reproduction which have been proposed, the most prominent is the uniform

system. I have been rebuked for not joining in the chorus of delirious approval which greeted the proposal to introduce this system into Burma, but I confess that I see in it mainly a reaction against the slovenliness of a Burma jungle. Mr. Leete, for instance, expresses a preference for dealing with a small area, and would evidently contrive that there at least the ugly hand of Nature should be no more seen. We are taught to regard the continental forests as the height of perfection, and it is perhaps not unnatural that we should aspire to reproduce in these forests the orderly and systematic arrangement of the growing stock which is the principal feature of those forests, but we have to consider not only appearances but practical results. Little attempt has been made to give a clear idea of the benefits which would result when the change is complete. I understand that eventually the stock will be arranged more conveniently for extraction, but the benefit is discounted by the fact that in most cases each log would still have to be dragged and floated out separately. Assuming, however, that the result will be satisfactory in the dim and distant future, it is perhaps my fault, or rather misfortune, that I cannot understand what is supposed to be the effect of this work during the next 150 years while the change is in progress. The fact that ample regeneration is effected naturally is an asset of considerable value, the more so as our forests are large and our staff small. So far as I can judge, however, we are required to dispense with this, and are to regenerate our forests entirely afresh and in an unnatural manner. This would be a colossal undertaking, and it is evident that the work would occupy our energies to the exclusion of all other work, and would result in a great increase of expenditure. It appears also that the change would prejudice, or at any rate prevent any measures being carried out to improve the yield during the next 150 years. While therefore our expenditure would increase, our revenue would decrease, or at best remain stationary, and the financial results would, I think, be deplorable.

17. Mr. Leete's proposal to establish more plantations seems more promising, as we know that this work at least is practicable, and the results certain. The first point that strikes me, however,

is that if plantations are desirable, his Division seems most unsuited for them, and compares unfavourably with Arakan. Not only is Pyinmana remote from the market, but there is already such a quantity of natural teak and Pyinkado that few plantations could be made without destroying some of it. In Arakan, however, although teak is not indigenous, it grows more rapidly in plantations than, I believe, in any other Division in Burma. The jungle consists also of pure bamboo which can be sacrificed without a sigh, and is more easily cut over for Taungyas than any other kind of jungle. The greatest attraction is, however, its accessibility. Thousands of acres could be planted up on hills which slope directly down to large navigable rivers, in which rafts and not merely single logs could be floated out to one of the best ports in India at all times of the year. If Mr. Leete's views are sound, the obvious policy would be to abandon Pyinmana to the timber firms, leaving perhaps a junior assistant to protect existing teak, and to concentrate in this division until Akyab is as bright and gay with forest officers as Pyinmana or Tharrawaddy. This seems to be the logical conclusion of Mr. Leete's views, but in the words of the poet "I don't think". Plantations for the richer Divisions are a thing of the past. They have been tried and found wanting, and I think Mr. Leete will find it impossible to reawaken any further enthusiasm. In Burma the country stinks of teak, and it seems, therefore, a futile proceeding to create teak artificially, and to spend the rest of our service in gradually hacking out about 90 per cent. Thinnings in even-aged plantations require skill, and may be congenial work, but it certainly seems more sensible and fitting that instead of spending all our time on hacking down immature teak, we should concentrate our energies on saving immature teak which would otherwise be killed by inferior species. If the natural teak were arranged tidily in even-aged gradations, as in plantations, Mr. Leete would be the first to insist that they should receive adequate attention. I am prepared to humour him so far as to admit that teak in existing plantations should be properly attended to but can he give me any reason why natural teak seedlings and saplings should not receive exactly the

same attention, and should not at regular intervals be allowed more room for development?

18. On the principle that a bird in the hand is worth two in the bush, a seedling or sapling on the ground is worth two in the womb of time, and I maintain, therefore, that our first duty is to look after what we have got before worrying about further reproduction. Wherever a wood is fully stocked, whether in a natural or artificial forest growth results in great destruction, and it is usually a forester's first aim and object so to regulate this destruction that the best and most valuable trees may reach maturity. Outside India it is recognised to be the height of folly to neglect thinnings in mixed woods, and in Burma although teak is well equipped for the struggle for life, we cannot expect more than a small proportion of the seedlings and saplings to reach maturity without assistance. Not only have we reproduction supplied free of charge, but the valuable species are distributed at such wide intervals that the waste inevitable in an artificial forest is avoided. We have, in fact, merely to remove species of no value to ensure that the majority of teak seedlings and saplings should reach maturity. Sylviculture in such forests is therefore very much more simple, and infinitely more profitable.

19. We have however large areas to deal with, and must therefore limit ourselves to the more pressing and useful works. Practical experience in carrying out improvement fellings (the form used to denote the rough thinnings practised in a natural forest), proves that it is possible to free all saplings and in many cases a large number of seedlings at small expense and to carry out the work over large areas. I maintain, therefore, that we could with advantage refrain from fire-protection and elaborate schemes for ensuring further reproduction, and should concentrate all our energies on carrying out this work on as short a rotation as possible. There can be no more effective way of increasing the growing stock of a species than by reducing the natural mortality to which it is subject, and there can, I think, be no doubt that it would result in a very great increase to the yield and that at a much earlier date than would be possible by any other

method. It is simple work and applicable to almost every forest, and it is, I believe, the only work of which no one disputes the value. I maintain also that although no special knowledge and no labour is required, further reproduction can be effected by this work, with more certainty and probably in greater quantity, than by any other method. I base my conclusion on the grounds which I do not think can be disputed, that ordinarily teak reproduction must increase in proportion with the number of saplings and seed-bearers saved from destruction by systematic improvement fellings. The elephant is known to be the slowest breeder of all known animals, and in order to illustrate the extraordinary effect of eliminating natural mortality, Darwin calculated that "after a period of from 740 to 750 years there would be nearly nineteen million elephants alive descended from the first pair." It is evident that exactly the same tendency to increase is displayed to a greater degree by a species such as teak. We, in fact, look after the saplings and seedlings already on the ground, and Nature does the rest. Could anything be more simple or more practical?

Mr. Leete has given us rather a depressing picture of the state of the Pyinmana forests. One gathers that a time will come fortunately when we shall have retired to the place where all good Anglo-Indians go,—where in this, one of the finest Divisions in Burma, teak for girdling will be conspicuous by its absence. This is, however, no isolated case. We know that all our forests are steadily deteriorating under our management, and that our record thus far has been one of failure and incompetence. One may well ask "Is this the result of Scientific Forestry? Have we not an uneasy suspicion that although we might be as wise as Solomon had we artificial forests to deal with, yet when it comes to the treatment of natural tropical forests we are mere children in knowledge?" The moral would appear to be that we should not meddle with things we do not understand. The teak we are girdling now has grown up without fire-protection, and we know that protection is not essential. By all means let us start carrying out experiments and attempt to learn something about it, but in

the meantime would it not be wiser to leave it severely alone? In the same way I venture to think that we know nothing about reproduction. There is no urgent need to arrange the distribution of teak unnaturally nor to carry out elaborate schemes to ensure further reproduction, and would it not be wiser therefore to wait a bit until we have something more definite to go upon?

I do not hope to get any pension for years and years but when I retire my parting advice is going to be "Don't advance beyond your knowledge."

H. C. WALKER.

AKYAB:
September 1912.

NEGLECTED BURMA.

The following figures giving the forest revenue and expenditure for Burma and the rest of British India respectively for the year *1910-11 are instructive* :—

	Revenue.	Expenditure.	Surplus.
	Rs.	Rs.	Rs.
Burma	1,00,70,117	38,42,799	62,27,318
Rest of India * (including Bombay, Madras and the Andamans).	1,73,22,595	1,10,48,295	62,74,300
Total ...	2,73,92,712	1,48,91,094	1,25,01,618
Add imperial receipts and charges ...	12,742	3,52,929	−3,40,187
Grand Total for British India ...	2,74,05,454	1,52,44,023	1,21,61,431

* This excludes imperial receipts and charges.

THE TREATMENT OF "IN" AND "KANYIN" SLEEPERS WITH *AVENARIUS CARBOLINEUM.*

At the suggestion of the Forest Economist 400 In (*Dipterocarpus tuberculatus*) and 400 Kanyin (*Dipterocarpus alatus*) sleepers were prepared in the Pyinmana Division and treated at Pyinmana with *Avenarius Carbolineum* between 31st July and 14th August 1912.

2. A first attempt was made in June to boil the sleepers with an open fire under the tank; this ended disastrously, as the oil boiled over, caught fire and both sleepers and tank were considerably damaged.

3. After this four underground flues were built of brick and over these were placed four strong tanks each capable of taking four sleepers. This did away with the danger of the oil catching fire. The sleepers were placed in the tanks, by means of pulley chains attached from a beam which ran above the tanks along rails.

4. The treatment was carried out as follows:—

As soon as the oil reached a temperature of about 160° the sleepers were put in, 4 in each tank (16 in all), and allowed to boil for an hour at a temperature varying between 160° and 190°. The temperature was not allowed to go above 200° as the oil then expands and there is danger of boiling over. At the end of the hour the fires were withdrawn and the sleepers left for another hour in the cooling liquid. At the end of the second hour the sleepers were removed and a further supply put in.

5. During the experiment a number of sleepers were weighed before and after treatment in order to calculate the amount of oil absorbed.

The average absorption per Kanyin sleeper calculated on 72 sleepers was 1·11 lbs.; the average absorption per In sleeper calculated on 168 sleepers was also 1·11 lbs. At the end of the experiment the last 4 In sleepers instead of being taken out at the end of the second hour were left all night in order to ascertain if the absorption would materially increase. The result was surprising, the average absorption per sleeper being 9·4 lbs. These sleepers were in the cooling liquid for 19 hours. It remains to be seen whether the absorption of 1 lb. after an hour's cooling is sufficient to protect the sleeper from rot and insects for a considerable length of time. Probably six or eight hours in the liquid would give more satisfactory results.

6. It is very difficult to determine the cost of treatment from the experiment. There was of course much expenditure that would not be incurred in the ordinary way. It may be taken that the cost of extraction and conversion of In and Kanyin is very little less than that of Pyinkado. The price of In and Kanyin sleepers would therefore exceed the price of Pyinkado sleepers by the cost of the treatment.* Taking the price of *Avenarius Carbolineum* as 2·4 annas per lb., the price of an In or Kanyin sleeper treated with *Carbolineum* would be roughly 3 annas more than the price of a Pyinkado sleeper. The sleeper would have a much greater length of life to justify the extra cost. This we shall not know until the sleepers have been down on the line for several years.

A. P. DAVIS.

[*Provided the royalty of Kanyin and In was the same as that on Pyinkado which, in any case, is a superior sleeper wood than the former species.—HON. ED.]

THE SAP OF THE NEEM TREE.

SIR,--About two months ago a Neem tree in the hospital compound here started exuding sap of a whitish colour very much in appearance like toddy. It had a strong odour of the ripe Neem fruit and was intoxicating in action as was evidenced by the swarms of drunken blue bottle flies crawling about on the tree where the sap was exuding.

This tree continued to exude about two pints of sap daily for nearly a month, and was largely resorted to by leperous persons who used to take the sap away in small pots which they hung up under the places from which the sap was exuding. They said it had the power of arresting the further development of the disease if taken internally.

Some wiseacres thought they had got an inexhaustible fountain of medicine and strong drink and tried to tap the tree for further supplies by driving large nails into it, but were sadly disappointed.

The excise people here when they heard of a Neem tree yielding toddy as it was commonly called by the natives began talking about bringing these trees under the Excise Act.

THAYETMYO:
5th September 1912.

D. A. ALLAN,
Extra Assistant Conservator of Forests.

A SUGGESTION FOR THE IMPROVEMENT OF THE STATUS OF, AND PENSION RULES FOR, PROVINCIAL FOREST SERVICE OFFICERS.

SIR,—The context of the letter signed " Dives " which appeared in the *Indian Forester* for August 1912, holds equally good for the Provincial Forest Service, both as regards pay and pension rules. The new scheme sanctioned last year for the Provincial Forest Service is indeed a great improvement over the old system for which the thanks of the Service are due to Government, but a further improvement in the scheme is called for if we compare the scheme recently sanctioned for the Provincial Service of the Public Works Department. The duties which a Forest Officer has to perform are, no one will deny, much harder than those of an Engineer, and the Forester deserves further consideration if we take into account the fact that he has to work in unhealthy and out-of-the-way places at very much greater sacrifice of health and personal comforts.

Similarly, owing to their having spent the best part of their lives in forests under very trying conditions, there are very few who survive for their pension.

I therefore suggest that a request to Government, who have already done so much for us, be made :—

1. To raise the status of the Provincial Forest Service to that of the same branch of the P. W. D. It will be observed from a perusal of the schemes of the letter that they reach Rs. 850 in twenty years by getting more in their annual increments than we do, while we cannot aspire to this until we are at the verge of retirement.

2. That pension should be allowed to us as follows :—

After completing 15 years' service one-third of average emoluments.

After completing 20 to 25 years' service half of average emoluments.

I should be glad to know of the views of others also on the subject.

"A PROVINCIAL."

PROTECTION OF WILD LIFE.

The following is the Bill to make better provision for the protection and preservation of certain wild birds and animals.

Whereas it is expedient to make better provision for the protection and preservation of certain wild birds and animals ; it is hereby enacted as follows :—

SHORT TITLE AND EXTENT.

1. (*1*) This Act may be called the Wild Birds and Animals Protection Act, 1912 ; and

(*2*) It extends to the whole of British India, including British Baluchistan, the Santhal Parganas and the Pargana of Spiti.

APPLICATION OF ACT.

2. (*1*) This Act applies, in the first instance, to the birds and animals specified in the Schedule, when in their wild state.

(2) The Local Government may, by notification in the local official *Gazette*, apply the provisions of this Act to any kind of wild bird or animal, other than those specified in the Schedule, which, in its opinion, it is desirable to protect or preserve.

CLOSE TIME.

3. The Local Government may, by notification in the local official *Gazette*, declare the whole year or any part thereof to be a close time throughout the whole or any part of its territories for any kind of wild bird or animal to which this Act applies, or for female or immature wild birds or animals of such kind; and subject to the provisions hereinafter contained, during such close time and within the areas specified in such notification, it shall be unlawful—

(*a*) to capture any such bird or animal, or to kill any such bird or animal which has not been captured before the commencement of such close time;

(*b*) to sell or buy, or offer to sell or buy, or to possess, any such bird or animal which has not been captured or killed before the commencement of such close time, or the flesh thereof;

(*c*) if any plumage has been taken from any such bird captured or killed during such time, to sell or buy, or to offer to sell or buy, such plumage.

PENALTIES.

4. (*1*) Whoever does, or attempts to do, an act in contravention of section 3, shall be punishable with fine which may extend to fifty rupees.

(*2*) Whoever, having already been convicted of an offence under this section, is again convicted thereunder shall, on every subsequent conviction, be punishable with imprisonment for a term which may extend to one month, or with fine which may extend to one hundred rupees, or with both.

CONFISCATION.

5. (*1*) When any person is convicted of an offence punishable under this Act, the convicting Magistrate may direct that any bird or animal in respect of which such offence has been committed,

or the flesh or any other part of such bird or animal shall be confiscated.

(2) Such confiscation may be in addition to the other punishment provided by section 4 for such offence.

COGNIZANCE OF OFFENCES.

6. No Court inferior to that of a Presidency Magistrate or a Magistrate of the second class shall try any offence against this Act.

POWER TO GRANT EXEMPTION.

7. Where the local Government is of opinion that, in the interests of scientific research, such a course is desirable, it may grant to any person a license, subject to such restrictions and conditions as it may impose entitling the holder thereof to do any act which is by section 3 declared to be unlawful.

SAVINGS.

8. Nothing in this Act shall be deemed to apply to the capture or killing of a wild animal by any person in defence of himself or any other person, or to the capture or killing of any wild bird or animal in *bonâ fide* defence of property.

REPEAL.

9. The Wild Birds Protection Act, 1887, is hereby repealed.

THE SCHEDULE.

(*i*) Bustards, ducks, floricans, jungle-fowl, partridges, pea-fowl, pheasants, pigeons, quail, sand-grouse, painted snipe, spurfowl, woodcock, herons, egrets, rollers and king-fishers.

(*ii*) Antelopes, asses, bison, buffaloes, deer, gazelles, goats, hares, oxen, rhinoceroses and sheep.

EXCAVATING A BURIED FOREST.

BY D. W. O. FAGAN.

Amid encircling hills, twenty miles south from Auckland, lies the wide expanse of the great Papakura Valley. Level as a billiard-table, covering an area of many thousand acres, the vast flat stretches away and away till it is merged in the blue distance of

the horizon. In reality the valley is a huge peat-swamp, partially dry in places, probably because of natural evaporation. Elsewhere, where artificially drained, it already carries smiling homesteads of rich pasture-land, and it needs no prophetic eye to see in the near future the whole expanse converted into meadow-land by the dairy-farmer. Meanwhile it is a scene of industry probably unique of its kind in the whole history of man's operations. Beneath the surface of the peat, where the soil has shrunk in drying or has been blown away, lie exposed to view the trunks of innumerable kauri-trees.

Their submersion for centuries in the semi-liquid peat has sufficed for the decay and disappearance of branches and crowns. Nothing but the solid heart-wood of the mighty trunks remains, and these are found lying in orderly swathes almost as regular in alignment as wheatstalk on a newly-reaped field. Scarce a trunk is out of rank. The thousand heads point all in one direction, as though the forest had originally fallen under the sickle of some careful reaper.

There is a mystery about these huge trees. How came they here? Not thrown higgledy-piggledy in inextricable confusion, as has been found to be the case in the uncovering of other buried forests, but each as truly placed as ever fell living tree under the axe of the timber-getter. Did the forest that once covered the wide valley fall at a blow before the scythe-stroke of some cyclonic giant of primeval days that roared its way among the hills? Or was there never a forest at all, and did the present flat once form the floor of an old lake or ocean-inlet, into which, singly or in twos and threes, the great trees were drifted through the ages by flood or tide? The solution of the problem opens a wide field of conjecture.

The recovery and utilisation of buried timber is no new thing among the host of the world's strange industries. For some hundreds of years the wood of buried and submerged trees from avalanche-filled valley or mountain lake has been recovered and worked among the Swiss Alps. Many a yeoman-farmer or squire of the western counties can point with pride to heirloom cabinet or carved four-poster of black bog-oak. In parts of Devon and

Somerset, I believe, it is still possible to come across old-world churches and even cottages floored and raftered with age-old timber dug from the hags of Exmoor and Dartmoor.

It may be doubted, however, if elsewhere in the world it is possible to find, duplicated in one spot, so huge an area of buried timber of such immense size, and at the same time offering such facilities of recovery. Certainly in no other country has the conversion of a prehistoric forest into marketable timber been attempted on so wholesale a basis, or with better promise of success. A company has recently acquired the right of timber-recovery over some thousands of acres, and their mill is already at work cutting the huge trees into planks and logs.

There is not much in the working of an ordinary lumber-mill with which the average magazine reader is not familiar. Here, however, one strikes a note of newness, even of romance. Of peculiarly stunted growth must needs be the imagination of the spectator who, watching the log-laden trolleys swing in on the tram-rails, does not confess a thrill of interested emotion!

How many ages have gone by since this huge twelve-foot log, with the mud and grime of centuries thick upon it, reared its high head among its forest compeers? How many cycles passed above its waving crown—passed and slipped into Time's forgotten gulf—ere came the final cataclysm that laid it low? Did the brooding moa scoop a nest-burrow among its huge root-buttresses? Could it speak, would it tell us of that legendary race of men who left the carved stone coffins in our caves and wrought the basalt columns that strew our hillsides? By what strange hap of Nature's chemistry has the age old wood been preserved in all its primeval soundness to furnish weatherboard and scantling to a modern world?

The kauri is not a Scotch fir or Norway pine. The great trees require elbow-room, and in living forests are widely apart, amid the undergrowth. But the thickness of the one-time growth of huge trees covering the flat may be judged by the amount of fallen timber embedded in the peat.

The estimated quantity of visible and millable timber per hundred acres of the area is computed at ten million superficial

feet, and beneath the surface, to a depth of thirty feet, the great balks are found in the same ratio of closeness.

Some idea of the immense size of the old trees is furnished by measurements of the solid heartcores now remaining. As in the case of branches and crowns, the softer sap-wood that once enwrapped the central cores of the living trees has long since disappeared ; so in arriving at a computation of former size a considerable addition to present measurements must be made. Many of the logs, as now found, show a girth of over sixty feet, by a length of eighty or ninety feet of straight timber free from knot or branch. The average measurement may be put at from thirty-five to forty feet in circumference, and hardly any of the trunks show a diameter of less than eight feet.

Everywhere about the swamp one sees signs of excavation where workmen are delving to uncover the timber, and very interesting is the manner in which it is unearthed and got ready for the mill. Pits are scooped in the peat on each side of the trunk, as it lies, to accommodate the sawyers. Working in these, and wielding huge cross-cut saws, the men cut the eighty-foot balks into lengths of twelve or twenty feet. Then the grips of a 'forest-devil' are brought into play, actuating a wire rope or massive chain with a lifting power of sixty tons. There is a rattle and clank of machines, a groan and strain of pulleys, and a coughing roar of steam—a strange sucking sound, like the kiss of a long farewell. The black lips of the peat roll back, the great log is torn from the embrace of centuries, swung up on to bullock tram or trolley, and hauled away on its last journey to the saw-benches.

The cut timber is perfectly sound and of excellent quality. It differs from kauri timber of to-day cut from the living tree only in the matter of colour, which is a dark-reddish brown approaching mahogany. It is perhaps too early to speak of its lasting qualities ; but, following on its long subjection to the preservative action of the peat, many experts have expressed an opinion that the wood should prove practically indestructible. At all events, to use an Americanism, Papakura Valley timber has 'caught on,' and a trade has been opened with the British markets. Already

the unique industry has passed beyond the region of pro
success.

Much diverse guessing has taken place as to the probab
of the wood now being utilised. It has been variously state
from two to three thousand years. The kauri-tree is of sl
growth, requiring a lapse of a thousand years ere maturity is
reached. Geology points to the fact that the peat morass now filling the valley has endured for at least another ten centuries; and if we add, say, five hundred years for the mature life of the forest ere its destruction, it is probable, in the case of the larger timber, that the estimate is fairly correct.

A wonderful place this swamp of the Papakura Valley, and—with the exception of some of the more famous goldfields—unsurpassed for wealth of natural production, area for area, by any place on earth. The peat is full of fossil gum, shed through unnumbered centuries by the trees that are now being dug out and utilised. Since the dawn of the gum-digging era, forty years ago, the value of the fossil resin recovered amounts to many hundreds of thousands of pounds. At the present day it is still being won in increasing quantity; and as the timber is removed and the work of drainage progresses, it is confidently expected that, rich as the return has been in the past, it is not a moiety of what the future may be expected to yield. In not a few parts of the area as many as five successive layers of gum have been found at varying depths beneath the surface—a fact that would seem to point to the supposition that in past ages forest after forest has grown, flourished, and passed away.

The valley presents a busy scene. Side by side with the excavations of the timber-workers are the deep pits of the gum-diggers. Gangs of men are hard at work grubbing out the precious lumps of resin from the black soil; others throw out the soakage of the all-pervading water with bailing-bucket or Californian pump.

Fifty pounds an acre is freely offered to the lucky farmer or settler-owner of a bit of swampland, with a royalty on all gum produced, for the right of digging and prospecting. It is a prosperous wind now blowing for the farmers of the valley. At the end

ns, the lessor, in addition to the consideration, which may reach a considerable figure, takes back his land markedly ed and enhanced in value by the deep digging necessary for ecovery of the resin ; and all this, of course, without any effort expenditure on his part.—[*Chamber's Journal.*]

"THE LARGEST PIECE OF RUBBER."

In our last issue we asked if any of our readers knew of the largest piece of raw rubber on record. We referred to a biscuit weighing 559 lbs., which was exhibited at the Rubber Exhibition of 1908, and also to a block which figured at several tyre exhibitions, and weighed about 8 cwt. This week we are enabled, by the courtesy of the St. Helen's Cable and Rubber Co., Ltd., Warrington and London, to publish a photograph of a piece of Fine Hard Para which they bought about five or six years ago. This block weighed nearly half-a-ton, to be exact 1,100 lbs., and was shown at several exhibitions about the country. It is claimed that this is the largest piece of rubber ever imported.—[*India Rubber Journal.*]